HISTORY

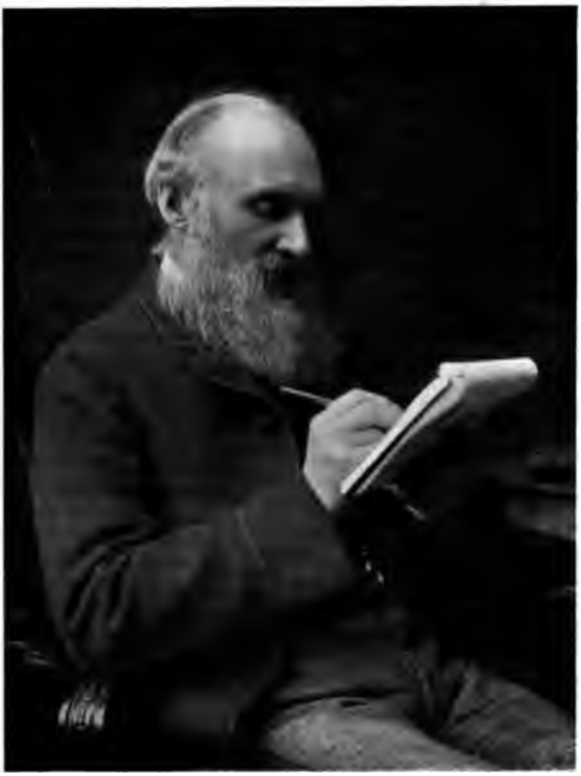
OF THE

GEOLOGICAL SOCIETY OF GLASGOW,

1858-1908,

WITH

BIOGRAPHICAL NOTICES OF THE MORE PROMINENT MEMBERS.



Lord Kelvin.

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EDITED BY

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PREFACE.

THIS volume has been issued to commemorate the Jubilee of The Geological Society of Glasgow. In the first chapter is given a brief sketch of the Geology of the Clyde Valley and notices of some of the earlier workers in this field. We are indebted to Mr. A. C. White for much of the material relating to the life of John Craig. The second chapter, dealing with the origin and early history of the Society, has been reprinted from the paper by Mr. Thomas M. Barr, in vol. vii. of the *Transactions*. Chapter iii. gives an account of the principal events that have taken place in the history of the Society since its foundation in 1858. The following five chapters give a summary of fifty years' work in the various departments of geological inquiry that have been pursued by the members of the Society. The titles and authors of the various chapters are as follows:—Physical and Dynamical Geology, by Professor J. W. Gregory, D.Sc., F.R.S.; Stratigraphical Geology, by Mr. Peter Macnair, F.R.S.E., F.G.S.; Palæontological Geology, by Mr. James Neilson; Mineralogy and Petrology, by Mr. Joseph Sommerville; Glacial Geology, by Mr. John Smith; chapters ix., x., and xi. contain biographical notices of some of the Society's more prominent members. The notices have been contributed by Professor Gregory, Dr. John Horne, F.R.S., Mr. Joseph Sommerville, Mr. Robert Dunlop, Mr. William Jolly, Mr. John Smith, and the Honorary Secretaries, Mr. Peter Macnair, F.R.S.E., F.G.S., and Mr. Frederick Mort, M.A., B.Sc., F.G.S. The Index has been compiled by Mr. J. W. Reoch.

GLASGOW, *28th December*, 1908.

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Introduction, with Biographical Notices of some Early Scottish Geologists.

Before proceeding to the more immediate object of this volume, namely, the origin and history of the Geological Society of Glasgow, we propose to give a brief sketch of the more salient geological features of the Clyde Valley, which district was to be, to a large extent, embraced in the labours of the future Society, and also briefly notice some of the more important workers in this field previous to the foundation of the Society.

Geographically, the mainland of Scotland may be divided into three great divisions—the Highlands, the Southern Uplands, and the Midland Valley—each of these being characterised by a particular group of rocks and by a scenic aspect of its own which is intimately connected with its geological structure.

The Clyde has its source in the Southern Uplands on the north-west side of the watershed, and flows northwestwards, crossing the entire breadth of the Midland Valley, abutting against the Highlands at the mouth of the Gareloch. The Firth of Clyde is bounded on the west by the Highland hills and on the east by those belonging to the Midland Valley. The true source of the Clyde is a matter of some dispute, though little Clyde Burn is usually considered to be the birthplace of our great river. This stream rises between Pin Stane (1695 feet) and Clyde Law (1789 feet), and close to the head streams of the Annan and the Tweed, from which point it flows westwards till it falls into the Clyde Valley proper a few miles to the south of Crawford village. The real source of the Clyde might rather be considered as the Daer

Water, which rises in Gadd Hill, in the extreme south of Lanarkshire, at an elevation of about 2000 feet above sea-level. From its source it flows northwards for about 10 miles, till it joins the Powtrail Water, and these united streams are termed in the Ordnance map the river Clyde. From this point the river keeps a northerly course till it reaches Lamington, receiving the Elvan Water, Camp Water, and the Wandel Water as tributaries. Between Roberton and Lamington the Clyde may be said to terminate the first part of its course to the sea, as it now leaves the great tableland of the Southern Uplands and enters the Midland Valley.

The broad tableland of the Southern Uplands is separated from the Midland Valley by a powerful fault, which throws down the later Palæozoic rocks to the north. The rocks which enter into the formation of this tableland have a general sameness of lithological character, and consist for the most part of grits, greywackes, flagstones, and shales, showing a continuous sedimentation from Arenig to Ludlow and Downtonian times, except in the north-west, where local unconformities occur. Certain of the black shales are richly charged with graptolites, and in the hands of Professor Lapworth these lowly organisms have served to demonstrate the order and succession of the strata. The rocks forming this tableland have been thrown into a complex system of isoclinal folds, those being often inverted and traversed both by normal and reversed faults. In the district round the source of the Clyde there is a great development of Ordovician rocks, including those of Arenig, Llandeilo, and Caradoc age. The Arenig rocks are exposed in the cores of numerous anticlinal folds, and one of their most interesting features is the presence of a group of volcanic rocks consisting of lavas, agglomerates, and tuffs. These volcanic rocks are succeeded by mudstones containing hingeless brachiopods, and by cherts charged with radiolaria. Above these come the Glenkiln and Hartfell shales yielding their characteristic graptolites, which are well

exposed in the districts of Abington, Leadhills, and Sanquhar. The lower Caradoc rocks of the Clyde district are represented by greywackes, shales, and fossiliferous conglomerates, while the upper Caradoc rocks find their representation in the Lowther shales, which to the east of the Clyde basin include the fossiliferous limestones of Wrae, Glencotho, and Winkston.

After passing Roberton and crossing the great boundary fault the Clyde leaves the old rocks of the Southern Uplands and passes on to the sandstones of Lower Old Red Sandstone age, and still further down the valley on to volcanic rocks belonging to the same geological period. Circling round the base of Tinto, which forms a conspicuous object in the landscape, and which consists of a great intrusive boss of felsite, the Clyde at this point winds across a flat mossy valley, receiving on the left the Garff Water. From its source till it passes near the town of Biggar the river flows in a north-easterly direction, but at this point it bends towards the north-west. It ought also to be noted that at this point the Clyde and Tweed approach to within a few miles of each other, being separated by a low tract of land, and it is said that in high floods the waters of the two rivers commingle with each other in a level tract formed by the Biggar Water.

Leaving the volcanic rocks of Old Red Sandstone age, the river has a short course over some of the lower members of the Carboniferous series, but again returns to the sandstones of Old Red Sandstone age near Hyndford Bridge. Beyond Hyndford Bridge the Clyde receives an important tributary, the Douglas Water. This tributary, along with the Logan Water, drains an area of exceedingly great interest to the geologist, and we leave the main valley to give a brief description of this particular district.

To the north of the great boundary fault strata of Upper Silurian age occur in the midst of the Old Red Sandstone area in two separate tracts, which have been revealed by the denudation of the later formations. These

occur along the crests of anticlinal folds, which run in a north-east and south-west direction. One of the areas of Upper Silurian rocks extends along the arch of the Hagshaw Hills north of Douglas, while the other is traceable from the Logan Water south-west by Nutberry Hill and Priesthill Height to the Greenock Water north of Muirkirk. In both these areas on the north side of the anticlinal fold there is a regular ascending series from the Upper Silurian rocks into the basement beds of the Lower Old Red Sandstone, while on the south side of the arch the natural succession is disturbed by a powerful fault. At the top of the series the strata consist of sandy flags and shales, with green shales, sandy mudstones, and sandstone bands graduating downwards into blue shales with calcareous nodules. These rocks have yielded the famous specimens of eurypterids and fishes.

Returning to the main valley of the Clyde at Hyndford Bridge, we find the river still keeping its north-westerly course across the Lower Old Red Sandstone. A little further to the north it enters the deep gorge which it has cut in this formation, and in which occur the Falls of Clyde. The Lower Old Red Sandstone in this part of the Clyde Valley consists for the most part of chocolate-coloured and grey sandstones, which have a great variety of textures, varying from hard, gritty beds to soft, fragile sandstones. The best sections of these beds are exposed in the river Clyde for a few miles above and below Lanark. At Stonebyres and Corra Linn massive beds of these chocolate-coloured sandstones and conglomerates, separated by thin, crumbling partings dip gently up stream.

After passing the falls the Clyde leaves the Old Red Sandstone part of its course and enters upon the Carboniferous Limestone series, over which it passes through scenes of surpassing loveliness until it reaches the Coal Measures near Dalserf, upon which rocks it continues as far as Glasgow. It is in these strata that the beds of coal and ironstone occur which have been of such great

importance in the industrial development of the Clyde Valley, and in this rich mineral district are situated the flourishing towns of Wishaw, Airdrie, Coatbridge, Motherwell, and Hamilton. In the neighbourhood of Uddingston and Bothwell the coal series is capped by a thick bed of red sandstone, which is the highest member of the formation. The gorge formed by the Clyde between these two places cuts through this sandstone. After leaving the true Coal Measures at Glasgow, the Clyde again passes on to the Carboniferous Limestone series, over which it flows as far as Kilpatrick. Below Bowling it begins to spread out into the Firth, and the river has here breached the interbedded volcanic rocks of Lower Carboniferous age, which rise into the Kilpatrick Hills on the north and the Renfrewshire Hills on the south. Farther down the river rises Dunglass Hill, formed by an intrusive plug of felsite. Beyond this we pass on to the Calciferous Sandstone series underlying the volcanic rocks, the former being pierced at Dumbuck by a volcanic vent, which has been filled up by ash or agglomerate, and which has subsequently been invaded by an intrusive boss of felsite. Farther down the river we reach Dumbarton Rock, which, like Dumbuck, represents the neck of an old volcano of Lower Carboniferous age. At Cardross the Lower Old Red Sandstone, with its characteristic plant remains, has been faulted into contact with the Upper Old Red Sandstone and the Lower Carboniferous rocks. A little way beyond Helensburgh the latter are brought against the crystalline schists of the Highlands by the great boundary fault which separates the Highlands from the Lowlands. On our left, and forming the hills above Greenock, occurs the volcanic series to which we have already referred, and on our right is the peninsula of Rosneath, across the extreme point of which passes the great boundary fault.

Rounding Kempoch Point a magnificent view is obtained of Loch Long and the Holy Loch, both of which trench deeply into the crystalline schists of the Highlands.

Near the upper extremity can be perceived the rugged mountain tops marking the highly convoluted belt of schists which passes through the centre of Cowal. From a steamer deck a fine view can be obtained, stretching southwards to Bute, the Cumbraes, and Arran, and the course of the Firth at this point seems to have been determined by the great boundary fault. On Blairmore Hill, rising between the Holy Loch and Loch Long, an intrusive sill of epidiorite forms a somewhat prominent feature, and a still more striking sill is to be seen in a ridge which rises from the sea near Hunter's Quay and stretches over Hafton Hill and up the side of Dunloskin.

Everywhere throughout the valley of the Clyde there are to be found abundant evidences of the former glaciation of this region. These consist of striated rock surfaces, boulder clay, moraines, erratic blocks, kames, and the Arctic shell beds which are chiefly developed along the lower levels of the valley.

Such, then, is a brief outline of the geological environment that was to call forth and nurture the future Geological Society of Glasgow, and sufficient has been said to show the unique character of the region and how almost every aspect of geological inquiry could be pursued in this highly favoured locality. The great variety of formations embraced in this region affords peculiar facilities for the study of structural and stratigraphical geology, and it will be seen that the Society has done a great deal to advance our knowledge of the geological structure of this part of Scotland. Again, the rich store of organisms entombed in the Ordovician, Silurian, Carboniferous, and Post-glacial deposits of this district has supplied a vast amount of material for the study of the past life of the globe, and it will be seen that the members of this Society have done much to advance the study of palæontology. Numerous valuable papers have also been contributed to the *Transactions* bearing upon the general principles of physical and dynamical geology. Within recent years the increased

application of the microscope to the study of rocks has caused a renewed interest to be taken in the minute structure and mineral composition of the crystalline schists and igneous and fragmental rocks of the Clyde Valley, and the younger members of the Society have already contributed quite a number of papers dealing with this important branch of geology. Much good work has also been done by members of the Society on the Glacial and Post-glacial deposits of the Clyde Valley.

We now pass on to notice some of the earlier workers in the geology of the Clyde Valley, and we mention first of all the Rev. DAVID URE, the historian of Rutherglen and East Kilbride. He was born in Glasgow. His father was an operative weaver, and David was trained in his father's profession. From his earliest youth he seems to have had a strong bent for study and an ambition to rise above the profession in which fortune had placed him. At an early age he developed a strong love of Nature, and it is recorded that during the Christmas holidays at college he walked from Glasgow to the summit of Ben Lomond when the ground was covered with snow.

While attending the divinity classes he acted as assistant to the schoolmaster of Stewarton, in Ayrshire. He also taught in a subscription school near Dumbarton. After being licensed to preach, he was appointed assistant to the Rev. Mr. Connell, minister of Kilbride, and it was during this period that he began his investigations into the archæology and natural history of the parish. Leaving Kilbride he went to Newcastle, where he acted as assistant in a Presbyterian chapel. Afterwards he was engaged by Sir John Sinclair to write the first sketch of the Agricultural Surveys of the counties of Roxburgh, Dumbarton, and Kinross. Headrick, in his memoir of Ure published in the *Scots Magazine* for December, 1808, says of him that, "whether travelling to gratify his own curiosity or to execute any commission, it was always on foot. Though short of stature, he enjoyed a sound constitution and a vigorous structure of body. He often

carried bread and cheese in his pocket, and enjoyed his repast beside the cooling spring. When his circumstances could afford it, he would repair to the village ale-house and enjoy his favourite luxury—a glass of ale. His greatcoat was furnished with a large pocket, in which he stored such minerals or other curiosities as had attracted his notice. He carried a tin box for stowing curious plants; a large cudgel armed with steel, so as to serve both as a spade and pickaxe; a few small chisels and other tools; a blowpipe with its appurtenances; a small liquid chemical apparatus; optical instruments, &c., &c., so that his friends used to call him a walking shop or laboratory. In this way he braved all weathers, and heat or cold, wet or dry, seemed equally indifferent to him. He was a patient observer and accurate describer of Nature. His descriptions were always taken down on the spot in a hieroglyphical species of shorthand invented by himself, and which, it is to be regretted, no one else but himself understood."

In the year 1796 Lord Buchan, in recognition of the valuable work that Ure had done, presented him to the church of Uphall, in Linlithgowshire. He did not, however, enjoy the preferment above two years, when he died of dropsy.

David Ure's book was published by subscription in Glasgow in the year 1793, and was entitled "The History of Rutherglen and East Kilbride, published with the view to promote the study of antiquity and natural history, by David Ure, A.M., preacher of the Gospel." The book was divided into two principal sections, the first being devoted to the antiquities and the general and statistical account of the two districts. The second section was divided into two chapters, and dealt with the natural history of the districts, living and fossil. The latter was divided into two groups, the native and the adventitious fossil. In the first he gives an account of the mineralogy, and in the second of the palæontology, of the district. The minerals were divided by him into earths, inflam-

Six Species of Carboniferous Microzoa.

Mounted by David Ure.

The Original in Kelvingrove Museum.

mables, salts, and metals. He also described the various rocks that occur in the district, and his opinions regarding their origin were greatly in advance of his time. The last chapter of the book is entirely devoted to a description of the fossils found in the neighbourhood, and is undoubtedly the most important part of the whole work. The numerous fine plates which illustrate the palæontology of the district have been executed with the greatest care and accuracy, so that most of the species figured in them can be easily identified.

An interesting relic of David Ure is preserved in the museum at Kelvingrove, this being a frame in which lie numbers of several species of Carboniferous microzoa. It has been made by cutting out a piece of cardboard into the form of a vase, along the widest part of which a row of six circular holes served as so many tiny boxes for the reception of the specimens. This was presented by him to Dr. Anderson, the founder of Anderson's College, and was recently given to the Museum by the Governors of the Glasgow and West of Scotland Technical College. A similar picture vase was presented by him to Dr. John Hunter, and is now preserved in the Hunterian Collection, Royal College of Surgeons, London.

David Ure's collection of fossils after his death passed into the hands of Mr. Stark, who presented them to the Royal Society of Edinburgh. This collection contained the original specimens figured in Ure's work. Since his time there seems to have been a steady gravitation of West of Scotland specimens towards the east, but since the recent development of the geological gallery at Kelvingrove an attempt has been made to keep western Scottish fossils in their own country, and it is to be hoped that this laudable effort will be supported by all those interested in the geology of this district.

Another important name in the early history of the geology of Lanarkshire is that of JOHN CRAIG.° He was born in the year 1796 at Airdrie, where his father was a

merchant. He was destined to show some genius as a writer, and to have that chequered career frequently associated with that genius. When John Craig was only four years of age his mother died. His father re-married in a short time, and soon afterwards he seems to have fallen upon evil times, and removed from the district. Young Craig's education was sadly neglected. According to his own statement, he was not more than six months at school. When he was nine years of age he was put to the weaving of muslin, a job he did not like, and he became notorious for spoiling his work. In 1808 he was at work alongside a Baptist preacher, who first inspired him with the desire to acquire education. Under this man's influence young Craig became a zealous Baptist. In 1811 he went to Paisley to a job at weaving. At this early age Craig appears as a theologian.

In 1812 he removed to Glasgow, where he also worked at the loom. At this time he read a number of books on theology, and seems to have been strongly convinced of the truth of the doctrine of reprobation. He wrote several long letters in its support, and gave them to some of his religious friends to peruse and give him their opinion upon them. Some of his friends were greatly pleased with these letters, and they fell into the hands of an influential Baptist in Glasgow. This gentleman was so much pleased with Craig's arguments in favour of Calvinist doctrines that he went with the manuscript to the place where Craig was at work and inquired if he was the writer of the letters, which he, of course, admitted. He took the youth home with him and introduced him to his circle of Baptist friends, who persuaded Craig to join their fellowship. The good man seems to have had thoughts of befriending Craig, but, if the following account be true, he took rather a strange method:—

"He was now taken from the loom and employed at four shillings a week as a reward for his love of brimstone." It was at the time of the dearth, and, as the quartern loaf was then 2s. 6d., he felt the pangs of

hunger, and he was forced to go back to the loom to procure food to keep him from starving.

Craig next appears as the village teacher and poet. Some time after this he came to work in his native town, and then went to Edinburgh for a time. In 1819 he settled at Airdrie as a teacher. He seems to have had advanced political opinions, and he wrote a philippic against the massacre of the Chartist demonstrators at Peterloo, near Manchester. This poem offended some of the local dignitaries, and Craig was obliged to retire to the parish of Shotts, where he taught in Green's school. Here he again put his foot in it by writing a satirical song on the barrenness of the parish, which pleased some but offended others. It was probably his experience as a teacher in Shotts that we have in one of his poems—"The Miseries of the Village Schoolmaster," from which we quote these lines—

To battle with the obstinate,
On dull stupidity to wait,
To force, to curb, to draw, to please,
To feel no hope nor joy nor ease;
Instead of oratory's sweet tone,
To hear a humm'd incessant drone,
To breathe infection from the crowd,
Until the pulse beats quick and loud,
The eyes grow sunk and red—to feel
The heart grow sick, the brain to reel;
And that he may not starve with pains,
To draw his grudg'd and scanty gains—
Such is the village teacher's fate.

Most of the poetry was in a rather melancholy strain, but Edwards considers that it possessed "considerable force and richness of expression."

Craig's next appearance was as lecturer on geology. In 1822 he was in Edinburgh, where he was for a short time employed as editor of *The Casket*. About this time he wrote several poems, including an "Ode to Silence," for *Constable's Miscellany*. He also kept a school at Echobank, near Edinburgh. In 1827 he published (at Edinburgh) a small volume of poems and songs, dedicated to the Countess of Wemyss and March. They procured

for him many worthy friends by their intrinsic merit, and were the means of introducing him to fame and public notice; some of them are charming.

He was afterwards employed as a teacher at Mr. Buttery's steel and iron works in his native district, and it was then that he began to study geology. Soon he was so proficient in this science that he obtained the premium for his accurate geological report of Lanarkshire. He was afterwards translated to Glasgow by the Town Council, and employed in making many geological surveys of public and private property. He also became a popular lecturer on geology, and appeared in this capacity at nearly every mechanics' institute in Lanarkshire. Besides his lectures, which were full of facts, he wrote several excellent geological treatises. He also contributed to many of the Glasgow papers, and his poetry appeared in the *Argus*. Edwards, who includes two poems by Craig in the fourth volume of his "Modern Scottish Poets," tells us that Craig ultimately went to America, where he became well known as a geologist. We have not been able to ascertain the date of his death, but it was anterior to 1882, when Edwards published the volume just mentioned.

Undoubtedly Craig's most important contribution to the geology of the Clyde Valley was his prize essay "On the Carboniferous Formation of the Lower Ward of Lanarkshire," which was published in the *Transactions of the Highland and Agricultural Society* in the year 1839. In this he laid the foundation of the stratigraphy of the Scottish Carboniferous rocks. The following extract from the introduction to his essay will give a fair idea of his methods of work and its geological scope:—

"In my journeys I was careful to make a complete collection of the rocks, erratic blocks, organic remains, and the series of specimens have been forwarded to the Society's museum. I may now state how I conducted my observations. I first traversed the boundaries or outcroppings of the Upper Red Sandstone, examined the

channels of the streams where it is developed, visited the different quarries, and noted down everything I considered worthy of observation. I then proceeded to trace, as accurately as the nature of the country would permit, the exterior boundaries of the Upper Coal series, indicated particularly on the north by the occurrence near the surface of a coarse grit, probably an equivalent to the Millstone Grit of the English coalfields. I then visited all the limestone and coal works included in the range of my survey, and collected all the information I could obtain, verbally or in writing, respecting the different beds of coal, limestone, and ironstone, and their associated layers, determining at all times from actual observation the level, course, and dip of the strata. My next, and not least arduous task, was to determine the northern limits of the Old Red Sandstone. In my wanderings I had also the trap rocks to attend to, and to ascertain whether they occur as dykes or overlying masses. To give anything like an accurate map or sections, all these observations were necessary, and, combined as they were with the tracing of faults, and the endeavouring to identify the respective beds of coal, ironstone, and limestone in different places, through the wide range of so extensive a survey, it will readily appear I had imposed upon myself a task which, however indifferently it may have been executed, was by no means easy or unimportant." He then subdivides the Carboniferous rocks of Lanarkshire in the following manner:—

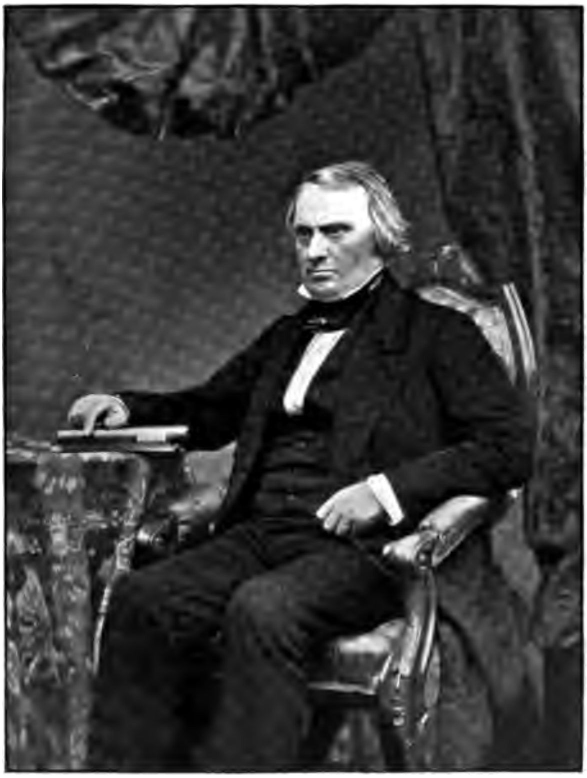
1. The Upper Old Red Sandstone series.
2. The Upper or Fresh-water Coal series.
3. The Lower Coal and Carboniferous Limestone series.
4. The Old Red Sandstone series.

Each of these subdivisions is then described in some detail, and the geographical distribution of the different series is illustrated by a coloured map, while their stratigraphical relationships are shown by a number of vertical

sections. From the above table it will be seen that Craig appears to have grasped the main feature in the stratigraphy of the Carboniferous rocks of Lanarkshire, and his subdivisions are practically the same as those adopted at the present time.

Dr. JOHN SCOULER* was another of the pioneers in western Scottish geology, and became President of the Society. He was born in Glasgow on the 31st December, 1804. His early days were spent in the neighbourhood of Kilbarchan, where his father was a calico printer, and there he received the rudiments of his education. While still at an early age he entered the University of Glasgow, and afterwards passed through the literary and philosophical classes, devoting himself to the study of medicine. It was while attending the class of botany—when the Chair of that science was occupied by Dr. (afterwards Sir William) Hooker—and the Botanic Gardens of Glasgow that Scouler first gave indication of the bent of his mind towards natural history. Dr. Hooker was not slow to discover and direct the tendency of his youthful pupil, whom he at once marked as being qualified for carrying on original research. In the meantime Scouler, having completed his medical curriculum in Glasgow, repaired to Paris, where, in the unrivalled collections at the Jardin des Plantes, he enjoyed ample opportunities of extending his knowledge of comparative anatomy. On his return from France he was, through the influence of Dr. Hooker, appointed surgeon and naturalist to the Hudson's Bay Company's ship, "William and Ann," destined for the entrance of the Columbia river in the year 1824. A detailed account of this expedition is given in a biographical notice of Scouler in volume iv. of our *Transactions*.

In 1833 Dr. Scouler was appointed Professor of Mineralogy to the Royal Society of Dublin. After spending twenty-one years in this post he resigned his office, the Royal Society giving him two-thirds of his salary as a retiring allowance.



John Scouler, M.D.

Introduction.

Dr. Scouler was President of the Geological Society of Glasgow from 1859 to 1862; afterwards, under the presidency of his friend, Mr. Smith, he held office as one of the Vice-Presidents till 1867. In all its proceedings he evinced a lively interest, and his ready and valuable assistance in the description and identification of specimens in palæontology was highly appreciated by the members.

Dr. Scouler while in Ireland examined several of the rarer Carboniferous fossils of that country, and prepared MS. notes upon them. Professor M'Coy (a pupil of Dr. Scouler's), in his "Synopsis of the Characters of the Carboniferous Fossils of Ireland," refers to these MS. notes, and uses the names proposed by Scouler for those undetermined species which he describes in his work. Professor M'Coy also names seven species after the doctor, in honour of his researches. Scouler was the discoverer of *Eurypterus Scouleri*, which was described by Hibbert, and which was referred by him to the genus *Eurypterus*, though Scouler himself had personally referred it to a new genus under the name of *Eidothea*. The original specimen is now in Kelvingrove Museum, to which it was recently presented by the Governors of the Technical College. Among his more intimate friends the specimen was known facetiously as "Scouler's auld head." A detailed description of this remarkable fossil has been given by Dr. Henry Woodward in his exhaustive memoir on the British *Merostomata* published by the Palæontographical Society.

The writer of an obituary notice of Dr. Scouler published in the *Glasgow Herald* gives the following description of his habits some years before his death:—"Those who knew Dr. Scouler intimately somewhat more than twelve years ago will recognise the fidelity of the following sketch. They will recollect that he then resided at the corner of Sauchiehall and Elmbank Streets. On going to visit him their nostrils were at once saluted with the odour of tobacco, and on entering, the doctor was

found dim-discovered through the smoke. When vision became at length distinct, the room was a perfect litter of books, every chair and table groaning under them. Conspicuous among them all were three folios, which were never absent—Aristotle, Hippocrates, and Ruddiman's edition of George Buchanan, who was always an idol. The other books were in all languages, for, besides the vernacular and the two learned tongues, Dr. Scouler was acquainted with the languages of France, Italy, Portugal, Spain, Germany, Denmark, Norway, and Sweden, and had also a smattering of the languages of the North American Indians. One table and the chimney-piece were generally reserved for bones and geological specimens, but most of these and his anatomical preparations were kept in a closet behind, into which he now and then disappeared to bring forth some specimen illustrative of his discourse. The central table was covered with manuscripts, and in the middle of it was a mound of cut tobacco, from which the doctor from time to time replenished his pipe."

Dr. Scouler died on the 13th of November, 1871, aged sixty-seven years, and his remains rest in the churchyard of Kilbarchan.

Other names might be mentioned in connection with the early study of geology in the West of Scotland. But many of these have become so well known in the history of Scottish geology that it seems scarcely necessary to do more than simply mention them. John Macculloch, the celebrated pioneer in Scottish geology, published the first geological map of Scotland in 1840, and in his "Western Islands of Scotland," published in 1819, he gave a description of the structure of the islands of the Firth of Clyde and the adjacent mainland. Macculloch, who was a native of Jersey, graduated in medicine in Edinburgh University, and was in 1811 employed by Government in geographical and other research in Scotland.

In 1827 Murchison and Sedgwick visited Scotland

together, and two years afterwards they contributed a paper to the Geological Society of London upon the "Geological Relation of the Secondary Strata in the Island of Arran." Afterwards Murchison described the rocks of the Highlands and Southern Uplands in a series of papers, and in his "Siluria" advanced certain theories regarding the structure and succession of the rocks in these areas, which will be referred to later on.

Professor R. Jamieson was one of the earliest writers on the mineralogy of the Clyde Valley, and, besides numerous papers scattered through his works, he wrote a separate book upon the mineralogy of the Shetland Islands and of the Island of Arran, published in 1798. Professor Jamieson was born in Leith in 1774. He was appointed Keeper of Edinburgh University Museum in 1792, and succeeded Dr. Walker as Professor of Natural History in the Edinburgh University in 1804. Jamieson was an eminent and enthusiastic follower of Werner, and for many years he was the President of the Wernerian Society of Edinburgh. One of the most distinguished of Jamieson's students was Ami Boué, who graduated in medicine in Edinburgh University, and shortly afterwards published his "Essai Géologique sur l'Ecosse," in which will be found numerous references to the rocks of the West of Scotland.

Another early writer upon the mineralogy of the Clyde Valley was Professor Thomas Thomson, who was born in Crieff in 1773. He was educated at the Universities of St. Andrews and Edinburgh, and contributed many articles to the "Encyclopædia Britannica," succeeding his brother in the editorship of the supplement 1796. Professor Thomson was the first to introduce the use of symbols into chemical science. In the third edition of his "System of Chemistry," published in 1807, he gives an account of the atomic theory of Dalton, which had been privately communicated to him three years before. Dr. Thomson was appointed to succeed Robert Cleghorn as Lecturer in Chemistry in Glasgow University in 1817,

and was afterwards appointed first professor of that science. In the year 1834 he was chosen President of the Royal Philosophical Society of Glasgow, whose meetings he attended regularly till his death. In 1836 appeared his "Outlines of Mineralogy and Geology," two vols. These contained a description of something like fifty new minerals which had been discovered within a period of about ten years, and many of which belonged to the West of Scotland. These minerals had been collected for him by P. Doran, a well-known dealer in geological specimens in Glasgow at that time. To the "Popular Cyclopedia," a Glasgow publication, he contributed an introductory treatise on the progress of physical science. Professor Thomson died at Kilmun, Argyllshire, 2nd August, 1852, in his eightieth year.

Reference has already been made to the fact that Craig published his memoir on the geology of Lanarkshire in the *Transactions of the Highland and Agricultural Society*. In these days that Society offered premiums for essays dealing with the geological structure of the counties or of some particular district of Scotland, the result being that many important papers on Scottish geology found their way into that journal. Two other important papers on local geology published in this way are those by Montgomerie on the "Geology of Renfrewshire and the North of Ayrshire" (1838) and Dr. D. R. Rankine's "Sketch of the Geology of Carluke" (1843).

Chapter II.

Origin and Early History.*

SITUATED as Glasgow is, in the centre of a district full of interest to the geologist, and drawing much of its wealth and importance from the extensive mineral fields by which it is surrounded, it was to be expected that the science of geology would early attract the attention of many living in the city, as well as of others in the district, who had perhaps even better opportunities for observation and research. Indeed, the wonder is that systematic study of the science should have been so long delayed. Geology, in its practical department, is closely allied to the search for hidden treasure, and Scotchmen are usually credited with being keenly alive to whatever affects their material interests. They may, indeed, be too cautious to put faith in the "Philosopher's Stone," but they are firm believers in any kind of stone which can be made a marketable commodity. It was not, however, in any mercenary spirit that the founders of "The Glasgow Geological Society" set about their labours. The actuating principle was simply a desire for knowledge—a longing to learn more of the mysterious structure of this wonderful creation on which we live and move; and I think it may be said with all confidence that every member of our Society has found himself amply rewarded by the knowledge he has attained and the pleasure he has derived from the prosecution of his studies. I can, at all events, say so much for myself, and the grateful feelings I entertain towards the Society have induced me to endeavour to put its early records in such a form as may prevent them being forgotten or lost altogether.

* Reprinted from a paper by Mr. T. M. Barr in *Transactions*, vol. vii.

Origin and Early History.

Before entering upon the origin and history of this Society it may be interesting to notice some of the previous attempts to form associations for the systematic study of geology, and the then existing means available for the diffusion of a knowledge of the science. I shall therefore endeavour to do this so far as time and opportunities have permitted, but as these have been very limited my sketch will consequently be incomplete. Other members may, however, be able to supplement it, so that we may yet have a tolerably complete history of the rise and progress of the study of geology in our city and district.

That the science did prove attractive to a popular audience may be inferred from the fact that one of a course of popular lectures delivered in the old Mechanics' Institution in Ferguson Street, Cowcaddens, when I was a small boy at school, was devoted to geology. The lecturer was the late Rev. Dr. Eadie, and his special object was to show the harmony between the observations and teachings of geologists and the Mosaic account of the creation. The lecture would not now perhaps be accounted very scientific, but we must remember the vast strides that geology has made since that time. I can remember little of the lecturer, but the effect remaining on my mind was so decisive that I never afterwards was disturbed by the fears and suspicions with which many have regarded the science and those who have devoted themselves to its study. About the same time Mr. Michael Connal, one of the members of our Society, had a class for young lads which met in the Spoutmouth, and it was his practice to walk out with them, on the Saturday afternoons during the summer months, to interesting country localities for the study of botany and geology.

I have been informed that an effort was made to establish a geological society in the city before 1850, but I have not been able to obtain any particulars, and the most reliable information seems to show that it never went further than a discussion of the project. At this period the local geologists appear to have communicated

the results of their observations through the Philosophical Society, *e.g.*, Dr. James Bryce read a paper on the "Parallel Roads of Lochaber," on 6th March, and another on "The Geological Structure of Roseneath," on 17th April, 1850.

The first geological society in Glasgow appears, therefore, to have been that formed in 1850, when, as the minutes bear--"At a conversazione held by the members of Mr. John Craig's class at its close, in Laming's Coffee House, 108 Argyle Street, on Monday evening, 1st April, 1850, Mr. A. M. Fyfe proposed that the members form themselves into a society for the advancement of the study of geology, which proposition was carried by acclamation, and a committee was appointed to draw up rules for the management of the Society."

This committee met in the same place on the evening of the 9th April, when a draft of the rules was prepared, and agreed to be submitted at the first meeting of the Society, on the first Tuesday in May, Mr. Fyfe agreeing then to read a paper on "Primary Formations." The meeting was accordingly held on 7th May in Picken's Coffee House, Mr. Craig in the chair. The draft rules were submitted and agreed to, rule No. 1 being, "That this Society shall be denominated 'The Glasgow Geological Society,' and that it shall have for its object the further advancement of the science among its members." The minute continues- "The Society proceeded to elect office-bearers, when the following gentlemen were agreed upon:—Mr. John Craig, *President;* Mr. Robert Barr, *Vice-President;* Mr. Donald Campbell, *Secretary;* Mr. A. M. Fyfe, *Curator;* Mr. David N. Chambers, *Treasurer. Directors*—Messrs. John Parker, W. C. Pattison, Provan, James M'Ewan, Hennedy, and Cameron. Mr. Fyfe then read an excellent paper on 'Primary Formations,' tending to prove that geology had a beginning, which gave great satisfaction to the members, and a vote of thanks was tendered to him. Mr. Campbell was ordered

to read the next paper, which was to be on 'The Cambrian and Silurian Rocks.'"

In addition to the names above given, there appear to have been the following members at this time:—Messrs. William D. Elliot, A. M. Humphrey, James Mavor, and William Black. The next meeting was on 3rd June, when "Mr. Campbell read a paper on 'The Lower Palæozoic Rocks,' embracing the varied stratified formations of the Cambrian and Silurian systems, with their origin, position, and fossiliferous contents, together with the wonderful structure exhibited in the formation of these early inhabitants of the globe. Mr. Barr was ordered to read a paper on the 'Old Red Sandstone' at the Society's first meeting, which was ordered for Tuesday, 8th October. The President then gave his parting address prior to leaving this country for the Rocky Mountains."

The next meeting was on 8th October, 1850, but Mr. Barr, instead of reading his paper on the Old Red Sandstone, gave the Society some extracts and communications from their late President's letters about his voyage to America, and also his geological prospects there.

The next meeting was in Picken's Coffee House on 5th November, 1850, when "Mr. Barr read an interesting letter from Mr. Craig, of Iowa, anent the discovery of some frogs in alluvial deposits, after which Mr. Barr read an admirable paper on the Old Red Sandstone."

"December 3rd, 1850, met this evening the Glasgow Geological Society in Picken's Coffee House, when Mr. Mavor read an interesting and valuable paper on the 'Coal Fields of Great Britain,' which elicited considerable discussion, tending to improve the members generally. Mr. M'Ewan was ordered to read a paper on 'The Iron Fields and Manufactures of Great Britain.'"

The next meeting, on 7th January, 1851, was devoted to the reading of some interesting information sent by Mr. Craig from Iowa relative to geological discoveries he had made there. The minute of next meeting proceeds—"On 4th February, 1851, met the Glasgow

Geological Society. Mr. M'Ewan read a most elaborate paper on 'Iron—Its Ores and Manufactures,' and was highly complimented by the members for the trouble he had taken in placing such a production before the Society. It was agreed that Mr. Kennedy Gill should read the next paper on Tuesday, 4th March, the subject being 'Copper—Its Ores, &c.' "

The minutes abruptly terminate at this point, the likelihood being that there were no other meetings, as the Society did not exist a full year, but they are interesting as indicating how the members proceeded to carry out the study of geology. It will be observed that they appear to have first set themselves to a general study of the great formations, rising from the Primary to the Carboniferous; that is, those formations which were easily accessible from Glasgow. They then seem to have taken up the economic uses of the rocks, and aimed at going through them systematically. Another feature is that the minutes almost invariably state that a member "was ordered to read a paper," as if there was some degree of compulsion. How would that work in our Society now?

Having traced out some of the members of this old Society, I am, by their aid, enabled to supplement the minutes in several particulars where they appear to be incomplete. No mention is made of the late Mr. Smith of Jordanhill, yet a deputation from the Society, consisting of Messrs. Craig, Campbell, and Fyfe, waited upon him by appointment, and asked him to accept the office of President. Mr. Smith received the deputation most courteously, and after a conference, in which he entered very fully upon the best way of conducting the Society, he closed by saying that, from his age and from his being so seldom in town, especially at night, he thought they would do better with a President from among themselves, but if his name would do any good he would gladly become Honorary President, and would charge himself to attend the anniversary meetings at least. Mr. Smith afterwards occupied the chair on the

occasion of a farewell dinner, in one of the hotels in town, in honour of Mr. Craig, previous to his leaving with his family for Iowa, and on that occasion he gave a most interesting account of the Geology of the Clyde Basin.

Another noticeable circumstance connected with the minutes is the absence of all reference to any excursions by the Society, from which it might reasonably be inferred that its work was restricted to the reading and discussion of papers. This would, however, be a mistake, as, on my applying for information on this point to Mr. Fyfe, he wrote in reference to excursions—"I can speak quite definitely as to these, and I think there were five, or perhaps six. The first was to the Kilpatrick Hills. We took steamer to Bowling and walked to Mr. James Ewing's gates on the Leven, where the gamekeeper was in waiting for us. Mr. Craig told him what we were in search of, and he immediately conducted us to the place on the very brow of the hill, where he left us. We spent some hours about, and were rewarded by many very beautiful specimens of gypsum, pure, very white, fibrous, and exquisitely crystallised. I have some of them still, and would recommend any walking geologist to take a tramp there, it was so abundant, and being in private grounds I cannot suppose it exhausted. It was perhaps a mile from the brow of the hill due S.E. from the gates, on the edge of a wide sheep-track before turning due south to Bowling Pier. I remember a ludicrous incident when walking down the hill towards Bowling, eight or ten of us, very tired, and most of us with bags over our shoulders. When nearing a gentleman's house we were observed, and being mistaken for visitors and friends of the proprietor, the family piper turned out and played a Highland welcome. Great was his indignation when he discovered the mistake, and folding up his pipes he walked off quite ashamed of his blunder. The next excursion was to Dalry, where we found abundance of very fine encrinites in a limestone quarry. The third was

to the neighbourhood of Coatbridge, but I recollect little of it. The other excursions are so mixed up in my memory with walks by two or three of us, which were not infrequent, that I must not venture to detail them."

After the breaking up of this Society, the popular study of geology seems to have reverted to the old desultory system of disjointed lectures and papers read at the Philosophical and other Societies, whilst there was an undercurrent working in less influential circles. There was founded on 9th December, 1854, a Mutual Improvement Association, composed of students attending the Glasgow Mechanics' Institution, North Hanover Street, and, as the only limitation made by the directors of the Institution was that no political or religious subject was to be discussed, the field was wide enough to take in geology; although I remember on one occasion a member objecting to an essay on that subject on the ground that it would lead to discussing theological questions. His objections were, however, overruled, but it serves to show the light in which the science was viewed in those days. Accordingly, we find in session 1855 one of the essays was a "History and Sketch of Geology." During the same session a deputation of the students waited upon the directors to urge on them the claims of geology as a subject to be taught in the Institution, suggesting a summer class similar to that for botany, so long taught by Mr. Roger Hennedy. This was so far successful, as we find in the thirty-third Annual Report, dated May, 1856—"The committee, at the request of the students of the previous session, advertised for a Lecturer on Geology and Natural History, but they were unsuccessful in meeting with an efficient Lecturer. In consequence, a course of lectures on Popular Anatomy and Physiology was instituted, and has been ably conducted by Dr. James Steven."

In session 1856-7 the programme of the Mutual Improvement Association comprised a series of four essays by as many members, taking up different sections

of geology in a somewhat systematic arrangement. In the same winter Dr. John Taylor took Geology as the latter part of his course of Popular Evening Lectures at the Andersonian University, and this seems to have been the first attempt made in our city to popularise the science by giving a comprehensive course of lectures on it. The first lecture was delivered on the evening of 12th January, 1857. Dr. Taylor defined geology as "one of the sciences which are occupied in the study of Nature. It inquires into the past condition of the earth, both as to its structure and its relations to the sun and other planets." After explaining the astronomical aspects of the science, and the relation of our earth to the other heavenly bodies, and the probable origin of the earth as a gaseous and then a fluid mass before it became solid, Dr. Taylor gave a general description of the earth, and stated that in his course of lectures he proposed to consider—first, the minerals; next, the important classes of animals; and third, the most important classes of plants. The lectures were continued weekly till the 28th April, when the session closed. The first four were devoted chiefly to the earth as a whole and its relation to the other members of the solar system. The lecturer entered very fully into the various theories as to the origin of the earth, and the arguments advanced in support of them, his previous lectures on mechanics and natural philosophy giving him great advantages in dealing with this part of the subject, as they enabled him to go much more into detail than he could otherwise have done with an ordinary popular audience. The conclusion arrived at, stated generally, was that the earth had originally passed from a gaseous to a fluid state, that the solid crust was now about 24 miles in thickness, but that 1000 miles of thickness, being influenced by the moon's attraction, were probably in a viscous or semi-fluid state, and the remainder was still fluid.

Dr. Taylor then took up the leading minerals, as quartz, felspar, mica, hornblende, augite, calcareous spar,

John Taylor, M.D.

gypsum, and chlorite, and, passing on to the rocks, first described the two great classes, volcanic and aqueous. When he came to treat of the fossiliferous rocks, he diverged into zoology, describing the four great classes of radiata, mollusca, articulata, and vertebrata, and their various subdivisions. He treated botany in the same manner. The students were thus enabled to follow the lecturer intelligently through his descriptions of the various fossiliferous beds, and understand the varying conditions of life which they indicated. A comprehensive view was thus given of the whole science of geology, and, although the field was much too extensive to be handled in an exhaustive manner, it must not be supposed that it was treated superficially. On the contrary, by numerous exercises given out to be worked at home, particularly on the first branch of the subject, and by periodic examinations on special nights set apart for the purpose, Dr. Taylor sought to make his teaching as thorough and efficient as circumstances would permit, and those who knew him will remember what a wonderful faculty he had for awakening in his students an enthusiasm almost equal to his own, and of exciting their interest in whatever subject he took on hand.

Dr. Taylor had at least three excursions with his class. The first was on Saturday, 24th January, to Stobcross, where there was an extensive deposit of stones from ship's ballast, which afforded an opportunity of seeing a variety of rocks. The second was on Saturday, 4th April, by 2.10 p.m. train to Campsie (now Lenzie) Junction, the party walking thence to Corrie Glen, and returning to the Junction. Geological excursions were not so common in those days as they are now, and quite a sensation was caused by the party passing through Kirkintilloch. Personally, Dr. Taylor was tall and thin, wore his hair very long, and usually had his hat stuck on the back of his head. He threw as much energy into his walking as he did into everything he undertook, and it was no easy matter to keep up with him. No wonder, therefore, that

his appearance in the village, followed, or rather pursued, by a straggling tail of fifty or sixty individuals of various sorts and sizes, mostly equipped with bags and hammers of portentous aspect, should have caused a complete stagnation in the local manufacturing industry. Every weaver quitted his loom and ran to see what was causing the unwonted stir out of doors, and various guesses were hazarded as to what all this could mean. It so happened that there was a general election about the same time, and the conclusion most favoured seemed to be that this unwonted display had a political significance, although this would hardly account for the hammers. Fortunately, the neighbouring Woodilee Asylum was not erected then, or there is no saying what the natives might have thought. The third excursion was on Saturday, 25th April, to the Hunterian Museum, then at the old College in High Street. Mr. Thomson reminds me of a fourth excursion to Robroyston, which had escaped my memory, as I was prevented taking part in it. This course of lectures, as before stated, terminated in April, 1857, a year before the formation of our Society.

Next session, 1857-8, Dr. Taylor's course of lectures was devoted to Mechanics, and there were no lectures on Geology at any of the Institutions in the city till the winter of 1858-9, when a course was delivered in the Mechanics' Institution by Mr. Thomas Struthers, then the head teacher in the Trades' School. Mr. Struthers also lectured in the same place during the winters of 1863-4 and 1865-6, the Rev. H. W. Crosskey afterwards becoming the lecturer during the sessions of 1866-7, 1867-8, 1868-9. There were no lectures in 1869-70, but they were resumed in the following winter, and continued uninterruptedly till 1881-2, when they were discontinued. Dr. Page lectured in 1870-1, Dr. Robert Brown in 1871-2, 1872-3, and 1873-4. Our esteemed Vice-President, Mr. John Young, began his course in 1874-5, carrying it on successfully till its close in 1881-2.

Having thus sketched, as fully as the available sources

of reliable information would permit, the early efforts made to further the study of geology and form a geological society in Glasgow, we may now turn to consider the particular course of events which led to the formation of our existing Society.

In connection with Free St. Peter's Church (under the pastorate of the late Rev. William Arnot) there had been for many years a very flourishing Young Men's Society, which held weekly meetings during the winter season from September to May, and at which papers were read and discussed on various subjects, among them geology appearing to have found a place. Thus the minutes bear that on 6th November, 1857, Mr. James Binnie "read his essay on geology, being the second of the course on the wisdom and goodness of God illustrated from science."

There had been a feeling growing among the members that it was undesirable to break up all connection during the summer months, and occasional excursions or picnics were made to the country, but some of the leaders thought it would be better to have more systematic arrangements and some definite end in view. Accordingly, at the annual business meeting held on 23rd April, 1858, Mr. Morrison, Vice-President, in the chair, the minutes state—"It was proposed by Mr. Hugh Reid, and agreed to, that a special meeting of the Society be held next Friday evening for the purpose of considering the following suggestions submitted to the Society by Messrs. Parker and Waddell, Vice-Presidents, viz.:—

"1st. The starting of a manuscript magazine in connection with the Society.

"2nd. The organisation of excursion parties for intellectual improvement during the summer recess."

It is interesting at this point to note the connection between this movement and some of the earlier movements already described. Mr. Parker, whom we now find taking the lead in this, is the same Mr. John Parker, formerly a member of Council in the Geological Society in connection with Mr. Craig's classes eight years before;

and his coadjutor, Mr. J. Gray Waddell, was for many years (previous to 1855) secretary to the popular evening classes at the Andersonian University.

The special meeting was accordingly held, as we find from the minute—"Within the session-house on the evening of Friday, 30th April, 1858, was held a special meeting of Free St. Peter's Young Men's Society. Mr. Parker, Vice-President, occupied the chair, and opened the meeting with prayer. . . . The Chairman having stated his ideas regarding the members forming themselves into sections for the study of 'natural science' during the summer recess, and several members having supported them, two sections (botanical and geological) were resolved upon. The organisation of each to be distinct and separate from that of the Society."

The minute only mentions that "a considerable number of members were present"—probably about twenty-five to thirty—and all present, except four, elected to join the botanical section. The four who selected geology were William Kirkland, Hugh Reid, Thomas M. Barr, and George M. Barr, and there was a good deal of merriment at the smallness of their number. These four had meetings in the session-house on the evenings of the 5th and 10th May following, to consider what was best to be done under the circumstances. They felt their number to be too small to make a successful geological section, and yet they were unwilling to abandon the idea, as there was reason to believe that a sufficient number of the public were interested in the study of geology to make a strong Society. They ultimately resolved to put an advertisement in the newspapers, calling a meeting of all willing to join such a Society, and also inquiring as to any similar society which might be already in existence for the study of the science.

This meeting was accordingly held, and perhaps the better way is to let the minute speak for itself—"Free St. Peter's Vestry, 17th May, 1858. Met Messrs. Wünsch, Rae, Thomas M. and George M. Barr, Fergus Ferguson,

William Kirkland.

James Ferguson, Gray, Alexander Ross, and Kirkland, who agreed that they, along with such members as may hereafter join them, shall constitute a Society for the study of geology.

"The following was agreed to as a basis of constitution:—

"1st. Name—That the name of this Society be 'The Glasgow Geological Society.'

"2nd. Objects—That its objects be to promote amongst its members the study of practical geology. That excursions be made by members at convenient periods to geological districts in the country, and that the services of a practical geologist be obtained to accompany and assist them in their examination of geological phenomena.

"3rd. Meetings—That meetings be held monthly (or oftener if found necessary) for reading papers and having conversations upon the science, and for exhibition of objects connected therewith.

"4th. Fee—That the subscription be 5s. for the summer season, and a small subscription be made in winter if found necessary.

"That the business of the Society be managed by a President, Vice-President, and four Members of Committee.

"The following parties were elected:—*President* (left blank); *Vice-President*—Edward Wünsch; *Secretary and Treasurer*—William Kirkland; * *Committee*—Alexander Ross, Thomas M. and George M. Barr, and James Rae, with power to add to their number.

"The Secretary stated that he had inserted, as directed, a notice in the *Scottish Guardian*. That the only letter he had received in reply was from a society (formed of some members of Dr. Lindsay's class) called 'The Glasgow Natural History Society,' advising our joining them.

* *Editors' Note.*—Mr. William Kirkland was born at Provanmill, near Glasgow, and was the first secretary of the Society. He died 14th March, 1897, after two weeks' illness, the result of an accident, aged sixty-nine. Mr. Kirkland was a man of high intellectual attainments, most unassuming nature, and an enthusiastic geologist.

After consideration, it was concluded that that Society did not give that prominence to geology nor the facilities for its study which were desiderated, but that the Secretary should correspond with them for co-operation.

"A communication was read from Mr. Parker stating that a Society existed for the prosecution of General Science, and that as this was the proper season they might be willing to prosecute geology, particularly this summer. The Vice-President and Secretary were appointed to inquire into its nature, and, if satisfied, upon what terms they would admit this Society as a distinct geological section.

"Mr. Parker further states in his communication that, having waited upon Dr. Bryce, the latter mentioned that, owing to his numerous duties at the present time, he was unable to give a lecture to the Society. He recommended a Mr. Cowan, of Barrhead, as a properly qualified person to accompany the members in that district.

"The Secretary stated that he had seen Mr. Young, of Campsie, recommended by Mr. Keddie, Mr. Frazer, and other geologists, and that he stated that he could not undertake to accompany the members, except to Campsie districts, and that these would afford four profitable excursions. The sum of £1 was agreed to as the amount of remuneration for the services stated, and that Mr. Young be informed that the members could not avail themselves of his services on Saturday, the 22nd inst., as originally proposed.

"Mr. Colin Brown, Virginia Street, having been proposed as a very suitable person for President of the Society, the Vice-President and Secretary were appointed to wait on him, with the view of inducing him to accept the office.

"It was agreed to hold the monthly meetings of this Society on the second Thursday of each month, and that the next meeting be held in M'Callum's Coffee House, at 8 p.m."

The only remarks I would make upon this minute are

that, from the second and fourth heads of the constitution, there is evidence that the members seem mainly to have had in view the original idea of a summer session with excursions. There seems also a slight mistake as to the proper name of the Society which replied to the Secretary's advertisement. The Society formed from Dr. Lindsay's class at the Andersonian University was instituted on 21st April, 1858, and was designated "The Glasgow Naturalists' Society." The change of the place of meeting was thought to be advisable, as the members now aimed at a wider range of membership than that originally contemplated.

The next meeting was accordingly held in M'Callum's Coffee House, Glassford Street—"M'Callum's Coffee House, 24th May, 1858, the Glasgow Geological Society met. Present—Messrs. Wünsch, Clark, Thomson, Dickson, George M. and Thomas M. Barr, Fergus and James Ferguson, Reid, Gray, Halliday, Rae, Armstrong, and Kirkland, who enrolled themselves as members of the Society. Mr. Wünsch occupied the chair. The minutes of last meeting were read and approved of.

"The Secretary stated that, in accordance with the minutes of last meeting, a letter had been sent to the Natural History Society, meeting in Dr. Lindsay's.

"The Vice-President and Secretary had been making inquiries regarding the Natural History Society, in order, if a satisfactory arrangement could be made, to co-operate with them, but had not been able to obtain as yet any information. The above parties were re-appointed. The Secretary reported that he had seen Mr. Brown, who expressed himself gratified at our formation into a society, and at his having been nominated President. His business arrangements would, he was afraid, prevent his acceptance, but he would consider the matter. He promised that meantime he would assist us in any other way which lay in his power. The Vice-President was appointed to wait on him again, and, in the event of Mr. Brown not accepting, Mr. Connal was suggested as a very proper

person to occupy the position of President. The Secretary stated that he had written Mr. Young, of Campsie, in accordance with previous minutes, and that in reply he received a letter accepting of the terms there proposed, and stating the following as four suitable excursions:—

"1st. South Hill and Craigenglen. The former having been formed by denudation, the latter as being highly charged with fossils.

"2nd. North Hill and Campsie Glen. The former hill is capped with lofty terraces of trap. In the glen are to be seen the junction of the trap with the Carboniferous beds, and the effects produced by the heat of the volcanic rocks.

"3rd. Corrieburn. Sections of strata of coralline and encrinal limestone and shales belonging to the mountain limestone series of the coal formation, and also junctions of the trap with the sedimentary rocks.

"4th. Spout of Ballagan. Vast series of thin bedded limestones and shales. The finest view of stratification in that quarter. Gypsum and jasper are found in the strata at the Spout. Dunglass Hill, opposite Ballagan, in the middle of the valley, a beautiful mass of columnar basalt.

"Some members having expressed themselves as gratified with the information which the letter conveyed, manifesting, as it did, Mr. Young's thorough acquaintance with the subject, it was then agreed that the four excursions be undertaken, and the first be made to Campsie on Saturday, 29th inst., at 2.10 p.m. It was further agreed that, as this excursion was a preliminary one, each member should be at liberty to take a friend with him.

"It was resolved that a notice of the Society being now established, and of the trip to Campsie, be sent to the Athenæum, Glasgow Public Library, Andersonian University, and other suitable places, and that the said notice be inserted in the *Herald* of Wednesday, *Mail* of Thursday, and *Bulletin* of Friday succeeding.

"It having been considered that many members of

Dr. Taylor's late class might be induced to join, the following were appointed a special committee to canvass for them:—Mr. Peter Halliday, Mr. James Armstrong, Mr. James Thomson.

"The following committee was also appointed to enlist members from Free St. Peter's Young Men's Literary Society:—Mr. G. M. Barr, Mr. T. M. Barr, and Mr. Hugh Reid."

From this minute it is evident that the Society had now been fairly set agoing, and the members were earnestly addressing themselves to the work for which it was constituted, and at the same time seeking to extend the membership, so as to establish the Society on a solid foundation.

The first excursion of the Society took place, as arranged, on Saturday, 29th May, 1858, a party of twenty-five leaving Dundas Street station by the 2.10 p.m. train for Campsie Junction, and walking thence by Kirkintilloch and Milton to Lennoxtown, where Mr. Young met them at the road leading to the Alum Works. Turning up this road, the party followed the Alum Works Burn to the South Hill, examining the boulders and beds exposed, and then passed on to Craigenglen, where a considerable time was devoted to gathering fossils. Having spent a most enjoyable afternoon, the party started to walk back to town, which was reached about half-past ten o'clock. Most of the members were well laden with "specimens," but it is feared that in many cases, for want of discrimination, the bulk was out of all proportion beyond the value.

The Society met in M'Callum's Coffee House on 31st May, when Messrs. Lang, Arneill, Carey, Yuille, York, and Winton joined as members. "It was stated that, owing to the Secretary (Mr. Hunter Finlay) being ill, no communication had yet been received from him regarding 'The Natural History Society,' meeting in the Religious Institution Rooms. Committee continued.

"The Secretary reported that the first excursion of the

Society had taken place on the previous Saturday as arranged, and Messrs. Thomson and Arneill were appointed to draw up a report of the excursion, to be read at the first monthly meeting; and, as several of the members had been unable to join in the excursion, it was agreed that a second should be made over the same ground on Saturday, 5th June."

The attention of the Society was now directed to securing a fixed place of meeting. Messrs. Wünsch and Carey were appointed to make arrangements for accommodation at the Athenæum, and it was agreed that the first monthly meeting on Thursday, 10th June, be held there. There is, however, no trace of this meeting being held. Probably something may have occurred to occasion its postponement, but the next minute is dated "Athenæum, 17th June, 1858.—Mr. Wünsch, *V.P.*, in the chair. Messrs. Horne, Dove, Naismyth, A. T. Williams, and Downes enrolled. It was reported that the second excursion had been made to South Hill, Campsie, and Craigenglen, under the guidance of Mr. Young, and a report of it prepared by Messrs. Thomson and Arneill was read by Mr. Thomson. Some conversation took place as to the desirability of getting up a library in connection with the Society, but further consideration of this was deferred. Mr. Horne also suggested the propriety of taking steps to form a museum. The third excursion was fixed for 19th inst. to the North Hill, Campsie, Messrs. Lang and Armstrong to prepare a report of it."

The third excursion was accordingly made on Saturday, 19th June, the party leaving Dundas Street station about one o'clock for Lennoxtown, where they were met by Mr. Young. Walking about two miles along the Strathblane road, they reached Campsie Glen, passing up which they had an opportunity of observing the various junctions of trappean and stratified rocks. Crossing the Fintry road, and passing along the face of the North Hill, they ultimately reached the lime quarries, where some

time was spent in fossil hunting, after which they returned to the city by train.

The Society met in the Athenæum on 1st July, 1858. Mr. Lang read a report of the excursion to Campsie Glen and the North Hill. The fourth excursion was fixed for Saturday, 3rd July, to Corrieburn. Messrs. Wünsch and Kirkland were appointed to prepare a report, and it was also agreed, on the suggestion of Mr. Horne, that specimens obtained should be exhibited for the benefit of members who might be unable to accompany the excursion.

A question arose at this meeting which occasioned some difference of opinion, and the discussion was renewed in connection with some of the other excursions. In those days the surrounding districts were not opened up by railways to the same extent as now, and it being difficult to get to some of the localities, except by hiring special conveyances, the point was whether these should be hired by the Society *qua* Society, or be hired by the individual members who took part in the excursions. The minute proceeds, "The meeting having considered it desirable that an omnibus be engaged for this excursion, the Secretary stated that Mr. Menzies would supply the vehicle for 45s. for not more than twenty-five persons. After consultation, it was found only thirteen members could agree to avail themselves of the conveyance. This number being insufficient, Mr. Lang proposed, and Mr. Armstrong seconded, a motion, 'That for this trip an omnibus be engaged by the Society, that those availing themselves of it be charged 2s. 6d., the loss, if any, to be sustained by the Society, and the surplus, if any, to accrue to its funds.' Mr. Thomson (Nile Street) moved, and Mr. Arneill seconded, an amendment, 'That the members availing themselves of this conveyance defray all its expense.' On a show of hands, the motion was declared carried."

At a subsequent meeting on 22nd July, the Secretary reported that seventeen members had gone by the 'bus,

and, at 2s. 6d. each, there was a deficiency of 2s. 6d., which it was agreed should be met by each of the members who had gone paying 2d. additional. There was nothing said as to what was to be done with the surplus of 4d. The same question was discussed in connection with the trip to Ballagan, Messrs. Lang and Armstrong moving, "That an omnibus be engaged by the Society, and members going pay 2s. 6d. each"; and Messrs. Arneill and Ferguson moving an amendment, "That members availing themselves pay the whole expense." The amendment was carried by a large majority. The funds of the Society were very limited, and one section of the members was jealous of any risk being incurred. The other argued that, as the members who went got all the hard work and contributed specimens and reports for the benefit of the whole Society, it was unfair to make them take all the risk of the hires.

There was another matter in connection with the excursions which came up for discussion several times, and was at last settled by a sort of "standing order," which does not appear to have been minuted. It was to the effect that at an excursion of the Society no member was to propose an adjournment to a hotel or public-house. There was no interference with individual liberty, but the object aimed at was that no one, while on a Society's trip, should be made to feel singular by not going into such places. It is but right to say that this was only a precautionary measure, nothing having ever occurred, so far as I am aware, to call for such a rule. The only general adjournment I remember was on one occasion when at Ballagan on a very wet afternoon. It rained all the time we were driving out and when on the hillside, so that we were very glad to get back to the village sooner than usual, only, however, to find that the horses were not sufficiently rested to resume the journey. There was no shelter available except in the half public-house and half farm, where the horses were put up, and

the whole party was soon crowded into the kitchen, to wait till the 'bus was ready. There was no lack of animal spirits, and, in our drenched condition, lots of good-natured "chaffing" at each other. One of the party, with a good deal of the "superior person" in his manner, discovering a large pot on the fire, said to the girl attending, "Ha, here's something hot; this will suit me." She naïvely replied, "Maybe it will; it's the cauf's supper."

To resume our narrative in chronological order. The fourth excursion was on Saturday, 3rd July, to Corrieburn, when seventeen members left George Square by omnibus at half-past two, and drove to Corrieburn, where they were met by Mr. Young, who had walked over from Lennoxtown. After spending some hours in the glen, they got back to town about half-past ten.

A special meeting was held on 20th July to consider "an offer made by Dr. Bryce, through Mr. John Parker, to act as guide to the members should they choose to visit Arran." It was agreed to accept of this offer, and a party went, but it was not very numerous, few of the members being able to spare the necessary time.

The next ordinary meeting was held in the Athenæum on Thursday, 22nd July, when the Secretary read a report of the trip to Corrieburn, and it was agreed to have a trip to Ballagan Glen on Saturday, 31st inst.

"Attention having been called by Mr. Armstrong to the constitution and rules of the Society, Mr. Lang moved, seconded by Mr. Armstrong, 'That a Committee, consisting of the Vice-President, Secretary, Messrs. Horne, Armstrong, Halliday, Ross, Lang, Barr, and York be appointed to draw up a code of new rules and submit it to next meeting,' which was agreed to."

The sixth excursion was to Ballagan Glen on Saturday, 31st July, by omnibus starting from George Square about two o'clock. This was perhaps one of the most enjoyable trips of the season. Mr. Menzies invariably sent four

finely-matched grey horses, with driver and guard in neat blue uniforms with silver-lace facings, the "turn out," as we drove through the streets, attracting considerable attention, and serving as a capital advertisement of the Society. Then as we went bowling along under the "Pen Brig" (now being demolished), through Maryhill and Milngavie, and over the hill towards Strathblane, where the Blane Valley comes into view, with Ben Lomond and his rugged neighbours for a background, there was a buoyancy and exhilaration of spirits which we miss in the prosaic railway journey of the present time. On this afternoon the weather was particularly fine, and, after reaching the "Spout," a small party climbed to the top of the hill and enjoyed the magnificent prospect of hill and dale, lake and mountain, reposing in all the glory of a golden sunset. It was a small party, and the members have since been scattered "wide as the world" apart, yet doubtless that summer evening still lingers as a bright spot in the memory of every survivor. As marking the progress made in our geological knowledge since then, it may be interesting to note that Mr. Young on that occasion, in describing the Ballagan beds, mentioned that it was not considered settled whether they were of Lower Carboniferous or of Old Red Sandstone formation, although generally believed to be the former. He also mentioned that they were not found further west than in Auchenreoch Glen, near Dumbarton. They have now been identified as far west as Loch Thom, on the Greenock Hills. After inspecting the Spout of Ballagan, the party crossed the Lennoxtown road, and ascended Dunglass Hill to view the columnar structure of the basalt and a travelled boulder on the top. Driving home, we reached the city about 10 p.m.

The next meeting was in the Athenæum on 12th August. At this meeting it was proposed that an endeavour should be made to arrange with the directors of that Institution for more permanent accommodation. The committee appointed at a previous meeting submitted a report, and,

after consideration, a code of twelve rules was agreed to. As they have never been printed it may be interesting to give them here complete—

Name. I. That the Society be called "The Glasgow Geological Society."

Objects of the Society. II. That its object be to unite into a recognised body all the friends and advocates of geological science residing in Glasgow and surrounding districts, and to encourage and cultivate geological science generally.

Government. III. That the affairs of the Society shall be conducted by a Council of Management consisting of nine, viz., a President, Vice-President, Secretary, and six members of the Association, who shall be elected at the annual General Meeting of the members in the October of each year.

Membership and Subscriptions. IV. Persons desirous of joining the Society are admitted on application to the President or Secretary, or by introduction of a member, on the payment of an annual subscription of 7s. 6d., or separately for the summer or winter session, 4s. each respectively. A donation of 20s. shall entitle the donor to membership for three years.

Honorary Associates. V. Persons distinguished as geologists, or known as friends and advocates of geological science, shall be eligible for admission as Honorary Associates, upon a recommendation by two members, and election by a majority of the members present at meetings when they are proposed. They shall enjoy all the privileges of members, but shall not be required to pay any subscription.

Museum and Library. VI. A geological museum and library shall be formed as soon as found expedient. Bye-laws to be added for their regulation.

Meetings of Members. VII. The regular monthly meeting of members shall take place on the first Thursday of each month, but the Council or Secretary may at any time call a special General Meeting, and shall be bound to do so on the written requisition of ten of the members, specifying the nature of the business to be transacted. At all general meetings of members the resolution of the majority shall be binding.

Annual General Meeting. VIII. The annual General Meeting shall take place on the first Thursday of October of each year.

Funds. IX. The Secretary shall receive and pay all moneys, keep regular account of the same, and have a balance of accounts prepared every six months, to be audited by two of the Council.

Excursions and Lectures. X. During the summer session the members will visit interesting geological districts under the guidance of a practical geologist, and in the winter session lectures and papers will be read by the members and Honorary Associates bearing on the science, specimens of fossils, &c., exhibited, and discussions carried on.

Sessions. **XI. The summer session to commence in the middle of April, and continue till the middle of September. The winter session to commence on the first Thursday of October, and end the first Thursday of March.**

Alteration of Laws. **XII. No alteration shall be made in these rules except at a General Meeting of the Society, specially convened for this purpose. Such alteration shall be tabled at one meeting, and discussed at a subsequent one, and shall not be adopted unless agreed to by two-thirds of the members present.**

The seventh excursion was on Saturday, 21st August, to East Kilbride, and the limestone quarries in that neighbourhood.

The eighth was on 28th August to Bishopbriggs quarries and Auchenairn, the freestone quarries being then in full operation in that district, though now abandoned. The "tirring" was very heavy, and some of the quarries were worked by mining.

Up till this period Mr. Young had acted as conductor at all the Society's excursions, except that to Arran.

The ninth excursion was to Hurlet and Barrhead on 4th September, the members going by train to Hurlet, and walking thence to Barrhead. The chief feature of this excursion was the examination of glacial action. Mr. Cowan acted as conductor.

The monthly meeting was held in the Lower Hall of the Athenæum on 9th September, Mr. James Horne in the chair, in absence of the Vice-President. Reports were read of the three trips which had been made since the previous meeting, and it was agreed to have another trip to the Barrhead district on the 11th and one to Coatbridge on the 18th September, which should terminate the season's excursions. A letter was read from Mr. Young with regard to forming a museum, in which he said, "If you could manage to get hold of the collection locked up in the Andersonian, and which was purchased by money subscribed by the people of Glasgow for the meeting of the British Association, it would enable you to lay the foundation of your museum. It is all a Scotch collection, and a great part of it is from the neighbourhood of Glasgow." (Is it yet too late to inquire as to this?) In

view of arranging for the winter session, the Secretary moved, and Mr. T. M. Barr seconded, that Messrs. Reid, Horne, York, and Armstrong, be appointed provisional members of Council.

The tenth excursion was made on 11th September, and was conducted by Mr. Cowan. On this occasion the party went by rail to Kennishead, where some sandstone and limestone quarries were visited. They then walked to Hurlet and visited the Alum Works, some of the more active going down the Townhead Pit on the alum shale. This was no joke, as the descent and ascent were made by a series of ladders; but once down the pit the exploration was easy enough. The only mishap was that two of the party got separated from the main body. One of their lamps had gone out, and in trying to light it the other lamp was stumbled against, and it too was extinguished, leaving the luckless pair in darkness and afraid to move. Being missed, however, a search party was formed, and, retracing their steps, the benighted men of science were soon relieved.

The eleventh excursion (and last of the season) was made on 18th September to Coatbridge and Baillieston. The party left Buchanan Street station about half-past two, taking the train to Coatbridge and walking back. After following the Monkland Canal a short distance, they came to the Glasgow road. At a pit close to the roadside, near Baillieston, they spent a considerable time on the shale-heaps, where some very fine specimens of ferns, chiefly *Pecopteris* and *Neuropteris*, were obtained, and, after getting their bags well filled, they continued their walk back to Glasgow. On the way home the party had the satisfaction of viewing "Donati's comet," then appearing in the northern sky. It was prominently visible for a considerable time afterwards, but as the period of its revolution is 2495 years, it is not likely to be seen again at any of the Society's excursions.

The summer season being now over, the Society addressed itself to the winter's work. At a special meeting

held on the 23rd September, it was agreed to accept the terms offered by the directors of the Athenæum for six months' accommodation. Mr. Horne reported that Mr. Colin Brown was unable, from business engagements, to accept the office of President. A committee was therefore appointed to wait on Mr. J. P. Fraser, to ask him to accept the Presidentship.

The first annual business meeting of the Society was held in the Board-room of the Athenæum on 7th October, when the committee appointed to wait on Mr. Fraser reported that he had consented to accept the office of President. He was elected with acclamation, and thus became the first President of the Society. "The financial statement of the summer session, from 13th May till 7th October, was then submitted, audited by Messrs. Barr and Ross. Receipts, £8 11s. 6d.; expenditure, £8 6s. 3d., leaving a balance in the Secretary's hands of 5s. 3d. Mr. Lang proposed, and Mr. Morrison seconded, the following gentlemen as office-bearers for the ensuing year:—*President*—J. P. Fraser, F.R.S.E., F.G.S.; *Vice-President*—E. A. Wünsch; *Council*—Messrs. Horne, York, Armstrong, Carey, Williamson, and Crosskey.

"Mr. Kirkland, owing to other engagements, tendered his resignation as Secretary. It was, however, arranged that he should hold office until a suitable successor should be elected."

During the session thirty-four members in all had joined and paid the subscription.

The winter session was opened on the 4th November, when the President delivered a lecture in the Lower Hall of the Athenæum on "Glacial Action"—Mr. Wünsch, *V.P.*, in the chair.

The next meeting of the Society was held on 18th November—the President in the chair—when the Secretary intimated that he had received a number of geological specimens, chiefly Silurian, from Dr. Sloan, of Ayr. Mr. Wünsch introduced the subject of a course of four lectures by Mr. D. Page, which had been

considered by the Council. The directors of the Athenæum had been approached, but they declined to co-operate with the Society in engaging Mr. Page. They may have thought the new society rather ambitious in seeking their alliance, or perhaps, as they had engaged the Duke of Argyll to give a lecture on "Geology: Its Past and Present," on the 13th January, they thought that was as much geology as the citizens could stand in one winter. After some discussion, it was resolved to make an effort to raise a guarantee fund to provide against possible loss, and the Secretary was authorised to treat with Mr. Page as soon as £15 was subscribed. This was accomplished in a very short time, and Mr. Page engaged to give four lectures on "The Past and Present Life of the Globe," in the Merchants' Hall, Hutcheson Street, in January and February, 1859.

The next meeting was in the Lower Hall of the Athenæum on 2nd December—the President in the chair—when Mr. Young delivered a lecture on "The Geology of the Campsie District." This lecture was printed in 1860, a list being appended of the fossils found in the district, and formed the first publication issued by the Society. It was illustrated by three sections--one across the valley at Ballagan looking west, one across the valley at Lennoxtown looking east, and a longitudinal section along the North Hill from Strathblane to Corrieburn. These sections do not seem to have been given in the second edition, which was printed after the first was exhausted.

The next meeting was in the Athenæum Board-room on 16th December, at which final arrangements were made for Mr. Page's lectures. Mr. Dennison, mining engineer, gave a description of the Lanarkshire coalfields, and thereafter presented to the Society a section he had prepared showing the strata.

On 14th January, 1859--Mr. Williams in the chair—the President gave a second lecture on "Glacial Action."

On 20th January Mr. A. Williams read a paper on

"The Geology of Arran," illustrated by a map and several sections which he had prepared.

The first of Mr. Page's lectures on "The Past and Present Life of the Globe" was delivered in the Merchants' Hall on 27th January—the President, Mr. J. P. Fraser, in the chair—the chairmen at the other lectures being—1st February, Mr. Walter Crum; 3rd February, Dr. James Bryce; 8th February, the President. The hall was well filled every night, Mr. Page being accompanied to the platform each evening by Professor Rodgers, Dr. Allen Thomson, Mr. William Keddie, Mr. Walter Crum, Rev. William Traill, &c. These lectures were also a financial success, as, instead of requiring to call up the guarantee fund, there was a surplus of about £7. It was afterwards agreed to present £3 of this sum to Mr. Page, making up his fee to £20, in acknowledgment of the very handsome manner in which he had treated the Society during the negotiations. The Society also added fifty-seven to its membership during the lectures.

The remaining lectures of the winter session were—

10th February, in Lower Hall of the Athenæum, when Dr. Bryce gave a lecture on "The Geology of Arran."

17th February, when Mr. Wünsch, Vice-President, read an essay on "Volcanic Rocks."

3rd March, a lecture on "The Igneous and Metamorphic Rocks" was given by Professor John Scouler, M.D., LL.D., F.L.S.

17th March, an essay on "The Geology of the South Downs of Sussex," by Rev. Mr. Crosskey, was given. At this meeting the Secretary read an abstract financial statement for the winter session, 7th October, 1858, till 17th March, 1859, audited by Messrs. Hugh Reid and G. M. Barr. Receipts, £62 6s. 6d.; expenses, £50 7s. 3d.; balance in Secretary's hands, £11 19s. 3d. There appear to have been ninety-nine members on the roll at this time.

Having thus completed a sketch of the Society's first summer and winter sessions, a very interesting testimony

to its success from the outside may be here introduced. We have seen that the suggestion which led to its formation originated with Free St. Peter's Young Men's Society, and, although the societies were quite independent, a connection was maintained for some time. It is not surprising to find the elder keeping an eye on the proceedings of the younger. In the report of the Directors, read at the annual business meeting of the Young Men's Society on 29th April, 1859, referring to the business of the special meeting agreed to at the previous annual meeting, they state—" The Botanical Section, under the guidance of Mr. Parker (to whom the credit of originating the movement is due), made regular excursions into the country for the collection of plants, and weekly meetings were held for their classification. The members of that section admit having received much benefit, physically and mentally, from their rambles. They look back with pleasure to the past and forward with hope to the future. They cordially invite all the members inclined to that delightful study to join their ranks.

" The Geological Section, under the able convenership of Mr. Kirkland, has been more ambitious than its fellow. It has grown into an institution, numbering among its members (now above one hundred) some of the most distinguished scientific men of the city and district. This section is now known as the 'Glasgow Geological Society.' During the season, under its auspices, lectures have been given by several eminent men. They correspond with leading geologists in all parts of the country. They also have had excursions during the summer months, for the collection of specimens, to different districts, and such an impetus has been given to the study of geology that it is said the price of fossils has already risen. The miners and quarrymen have come to see at last one kind of value in the old 'stane fish.' One other fact in connection with this may be mentioned. It will be most interesting to members to know that a

society has been formed in London on the model of that which Free St. Peter's Young Men's Society originated in Glasgow."*

At the next annual business meeting of Free St. Peter's Young Men's Society on 27th April, 1860, the Directors report—"The section for the study of botany was not resumed last year, but during the recess the members had a trip to Balloch and Loch Lomond on Queen's Birthday."

No further reference is made in the minutes of that Society to either the Geological or Botanical Section. The Botanical one does not seem ever to have been revived.

A meeting of the Geological Society was held on the 14th April, 1859, at which the arrangements for the summer session were fixed. These comprised six excursions to the Campsie district—1st. Ballagan Glen and Dunglass Hill. 2nd. Craigmaddie Moor and the Auld Wives' Lift. 3rd. Alum Works Burn and Craigenglen. 4th. Millburn and Ferret's Glen. 5th. Balgrochan Glen. 6th. Corrieburn. Besides these, there were during the summer excursions to Auchenreoch Glen, East Kilbride, and Bishopbriggs, and the Society also inaugurated this year the Queen's Birthday picnic, the spot selected for this excursion being Spittal Glen. Dr. Scouler, Dr. James Bryce, and Mr. John Young, of Campsie, were unanimously elected Honorary Associates, being the first elected by the Society.

"The first excursion of the season was to Ballagan on the 7th May, but it was an unpleasant contrast to our visit the previous season, a fine forenoon being succeeded by a very wet afternoon and evening, which marred the enjoyment of the members."

* This may refer to the "Geologists' Association," which originated from a letter signed W. J. Haywood, in the *Geologist* of August, 1858, leading to a meeting being held on 29th November, at which a Provisional Committee was appointed to take steps for the formation of a society. A prospectus was issued on 6th December, and the first meeting of the Association was held on 11th January, 1859. The programme and aims of that Association are similar to those of our own Society.

On 7th July it was agreed "to hold fortnightly meetings during the summer for the purpose of exhibiting, naming, and exchanging fossils, and for conversation thereon."

The second annual business meeting was held in the Religious Institution Rooms on 6th October. Up till this date the whole of the office-bearers were elected annually, but as this was found inconvenient a change was made in the rules. The following extracts from the minutes will show the more important business of the meeting:—

"The following amendment on Rule III. was proposed by Mr. T. M. Barr, seconded by Mr. Campbell, and agreed to, 'That the affairs of the Society shall be conducted by a Council of sixteen, viz., a President, two Vice-Presidents, and a Secretary, each of whom shall be elected annually, and twelve members of Council, six of whom shall retire annually, but shall be eligible for re-election. The election to take place at the annual meeting in October of each year, and shall be conducted in the following manner:—The name of each gentleman nominated, after being proposed and seconded by two of the members, shall be written down by the Secretary. Each member shall then write on a slip of paper the names of those for whom he votes, and those gentlemen having the greatest number of votes shall be declared duly elected. Should any vacancy occur during the year, it shall be filled up by the members of the Society at the first business meeting after the notification of such vacancy.' Mr. Horne proposed, and Mr. Henderson seconded, an amendment on Rule IX. to the effect, 'That the balance of accounts be audited by two members of the Association, instead of two members of Council.' Agreed to.

"The Secretary submitted a statement of accounts for the past six months, from 17th March till 6th October. Receipts, £15 16s. 9d.; and expenses, £13 8s. 7d., leaving a balance of £2 8s. 2d. in favour of the Society. The Vice-President and Secretary thereafter tendered their resignations of their respective offices, which were

accepted.* The meeting then proceeded to the election of office-bearers for the ensuing year, when there were elected—*President*—Mr. J. P. Fraser, F.G.S., F.R.S.E.; *Vice-Presidents*—Messrs. Thomas Struthers and John Young; *Secretary*—Mr. James Horne; *Council*—Messrs. E. A. Wünsch, James Armstrong, William Kirkland, T. M. Barr, James Thomson, John Dennison, William Carey, H. W. Crosskey, J. C. Douglas, William Johnstone, James Stewart, and Thomas Henderson. . . .

"Mr. Young stated that the collection of the late Mr. Cowan was for sale at present, and that it might be obtained for about £20. A subscription was originated among the members present for the purpose of acquiring it for the Society. £7 8s. 6d. were subscribed."

This was the same Mr. Cowan who had acted as guide to the Barrhead district at the Society's excursions of the previous season. He died from the effects of an accident. The Society was ultimately successful in securing his collection for the museum.

The principal features of the ensuing winter session were a second course of four lectures by Mr. Page on 1st, 7th, 15th, and 22nd December, the subject being "The Geological Aspects of the Coal Formation"; a lecture on "Earthquakes and Volcanoes," by Professor Rodgers of the University; and essays on various subjects by members of the Society, including "British Mining," by Mr. Mark Friar; "Certain Points of Contact between Geology and History," by Dr. Bryce; "Succession of Extinct Organic Forms," by Mr. William Keddie; "Relative Antiquity of Existing Species" and "Osteology," by Dr. Scouler. There was also a course of lectures conducted by Mr. Thomas Struthers, *V.P.*, and intended to teach the rudiments of the science to beginners. The meetings on the whole were well attended, and the Society made fair progress, although it had to contend against the counter attractions of the "Volunteer movement," which

* These were Mr. Wünsch and Mr. Kirkland, who had been respectively Vice-President and Secretary from the inauguration of the Society.

was entered upon very enthusiastically by the young men of the city during this season.

Such, then, is a sketch of the origin of our Society and of its work during the first two years of its existence. I have already mentioned that Mr. Young's paper on "The Geology of the Campsie District" was published in 1860, but although headed "Transactions of the Glasgow Geological Society," it does not bear any further reference markings, as if the editor was not at all sanguine of having any more "Transactions" to publish. A second edition of this paper was published in 1868, and is marked "Vol. I., Part I." The second publication was a paper on "The Phenomena of the Glacial Drift of Scotland," by Professor Arch. Geikie, in 1863. A second issue of this has also been made, the first having been entirely sold out. In 1865 the minutes of the Society's meetings were included in the *Transactions*, so that from that time there is a clear record of the Society's work.

The rules were printed for the first time in 1860. These were revised and altered in 1864-5, and again in 1874-5—another illustration of the truth of the saying that "Constitutions are not made, but grow."

The first complete list of the members was issued in 1860, and gives the names and addresses of 178 members. It was lithographed in view of a general canvass to increase the membership, as it was thought desirable that members should know who were already on the roll. On looking over the last list, printed in 1876-7, it will be found to contain the names of five members who joined in 1858, and seven who joined in 1859. Of these, several have since dropped off, so that those who participated in the early struggles of the Society are fast disappearing. It may be interesting to mention that all the four with whom the idea of starting the Society originated are still alive,* but only one, Mr. William Kirkland, is now resident in Glasgow; Mr. Hugh Reid is in Cardiff, and Mr. G. M. Barr in Otago, New Zealand, whither he went in

* This was written in 1882.—[Ed.]

1862. "Men die, but mankind has an enduring existence," so, although the old members pass away, there are new members stepping into their places, and the Society has now an assured position, little dreamt of when it was first started. Several of the members have distinguished themselves in special fields of investigation, as Mr. James Thomson, in the "Corals"; Mr. James Dairon, in the "Graptolites"; Mr. Wünsch, in the "Arran Volcanic Ashbeds"; Mr. David Robertson, in the "Post-tertiary Deposits"; and there is no greater living authority than Mr. John Young on the "Geology of the whole of the West of Scotland District." Good work has also been done by other members, so that the Society may fairly claim to have made its mark on the progress of the science. Its "coming of age" was duly celebrated; let us hope that when its "jubilee" comes round it may be celebrated under even more auspicious circumstances, and that when the members then pause to look back they may be interested to know something of the origin and early history of their Society.

NOTE [*Feb.*, 1883].—I have just had my attention called to evidence of the existence of a "Glasgow Geological Society" in November, 1840, from the handbill, just presented to the Society by Mr. John Wilson, of which a copy is subjoined.

I have not, however, been able to find any other trace of this Society. I have made inquiries of some of the old members of Mr. Craig's classes, and of others whom I thought likely to be able to give me information on the subject; but not one of them had even heard of the existence of a Geological Society in the city in 1840.

Mr. Craig was a mineral surveyor, and he taught several classes during the winter seasons. It is possible that the advent of the British Association may have induced the members of some of those classes to assume the title and try to establish a society, but the attempt does not seem to have been attended with much success, or to have left any other evidence of its existence than the notice in this old handbill. T. M. B.

UNDER THE PATRONAGE OF THE HONOURABLE THE

LORD PROVOST & MAGISTRATES

OF GLASGOW,

THE VERY REV. PRINCIPAL MACFARLAN,

VICE-PRESIDENT OF THE BRITISH ASSOCIATION,

AND PROFESSORS OF THE UNIVERSITY.

MR CRAIG

Most respectfully announces that he proposes giving TWO LECTURES on the

GEOLOGY & MINERAL RESOURCES OF THE WEST OF SCOTLAND,

IN THE.

TRADES' HALL,

ON THE AFTERNOONS OF

MONDAY and WEDNESDAY, the 7th and 9th Dec. at 3 o'Clock.

The same Lectures will be repeated on the Evenings of the same days at a Quarter past 8 o'clock.

THE FIRST LECTURE

Will illustrate the phenomenon connected with the Trap Formations of the West of Scotland; the Minerals peculiar to these; their modes of occurrence and origin; the Alluvial and Diluvial Deposits, with the evidences they afford of the Changes of the relative Levels of Sea and Land. Also, a general view of the Nature of the Metamorphic Rocks, Conglomerates, and Red Sandstones of Argyle and Dumbarton shires, and the adjacent Coasts.

THE SECOND LECTURE

Will embrace, with many additions, the substance of Mr CRAIG'S Paper, laid before the last meeting of the British Association, viz.—A Description of the Coal Formations of the Counties of Lanark, Renfrew, Dumbarton, and Ayr, with notices of the Vegetable and Animal Remains characteristic of the different Divisions of the Stratification.

The Lectures will be illustrated by Diagrams and Drawings, and the Maps and Sections prepared by Mr C. for the Glasgow Committee of the British Association, and exhibited at the recent Meeting in Section C, and by Specimens of the Rocks, Minerals, and Organic Remains.

" Glasgow College, 18th Nov. 1840.

"We consider that the above Lectures are well worthy of public patronage, and that Mr CRAIG'S exertions in developing the mineral resources of the country are worthy of every encouragement.

" WILLIAM COUPER, Professor of Natural History.
" THOMAS THOMSON, Professor of Chemistry.
" J. P. NICHOL, Professor of Astronomy.

" Glasgow College, 24th Nov. 1840.

" I concur in the above recommendation.

" D. MACFARLAN, Principal, Vice-Pres. Brit. Asso."

EXTRACT FROM THE GLASGOW NEWSPAPERS OF SEPTEMBER, 1840.

" Dr Buckland, no mean authority on such a subject, stated that Mr Craig's paper was the most important practical communication ever laid before the British Association."

Tickets, admitting to both Morning Lectures, 3s. 6d. each—to both Evening Lectures, 2s. each: Admission to a Single Lecture—Morning, 2s. Evening, 1s. 6d.

To be had of Messrs John Smith & Son, 70 St. Vincent Street; J. Finlay, 40 Buchanan Street; Thomas Murray, 8 Argyle Street; D. Robertson, 188 Trongate; John M'Leod, 20 Argyle Street: A. Rutherglen, 84 Trongate; John Morrison, 27 Bridge Street; and the different Members of the Glasgow Geological Society.

Glasgow, 25th Nov. 1840. W. & W. MILLER, Printers, 90 Bell Street.

Chapter III.

Chief Events in the History of the Society since its Foundation.

THE early history of the Society has been sketched by Mr. Barr, and forms the second chapter of this work. Since then the main events in its life are connected with the papers published in the *Transactions*, which constitute by far the finest monument of its existence. The progress of the various branches of geology, as reflected in our *Transactions*, is treated with some detail in later chapters, and this section records only a few of the more outstanding incidents in the Society's career not directly connected with the contributions to knowledge published by it.

One of the most agreeable witnesses to the good-fellowship that seems ever to have united the members of the Glasgow Geological Society is to be found in the readiness displayed to congratulate, often in a handsome way, any member who may have deserved well either of the Society or of the science it cultivates. Of the early members, none has left a more distinguished name than James Smith, Esq., F.R.S., of Jordanhill. In the spring of 1866 his portrait, finished in oils, was presented to the Society by a few of its members.

In December, 1872, a particularly successful conversazione and exhibition of specimens was held in the Corporation Halls. A large and representative company of prominent citizens and men of science took part in the meeting. The exhibits seem to have been of a particularly fine character. They were described by the press as "certainly the finest geological exhibition that has ever been held in Scotland,

and one which has probably never been equalled elsewhere in Britain." This can be readily understood when the names of the exhibitors are mentioned, many of them having the finest private collections in the country in their own lines. Specimens were shown by Mrs. Robert Gray and by Messrs. James Thomson, John Young, James Armstrong, E. A. Wünsch, D. C. Glen, David Robertson, James Dairon, Dugald Bell, A. Pratt, and others.

In 1874 Mr. John Young, of the Hunterian Museum, was appointed Lecturer in Geology to the Mechanics' Institution. To mark their appreciation of the services Mr. Young had rendered to the Glasgow Geological Society, the members presented him with a diploma of life-membership of the Geological Society of London, an aneroid barometer, and a purse of sovereigns.

In 1879 the Society attained its majority. The event was celebrated by a supper party in the Alexandra Hotel on 23rd February, 1880. Mr. D. C. Glen presided over a large company, and so enjoyable was the evening that hopes were expressed that it would become an annual gathering. At this meeting notes on the early history of the Society were read by Mr. Barr, and this was the nucleus of the valuable paper which was afterwards printed in the *Transactions*, and which forms Chapter II. of the present volume. The majority of the Society was also marked by an important event in its history, namely, the removal to the present convenient rooms in Bath Street. For a long time meetings had been held in Anderson's College, but in November, 1880, the Society met in the rooms they have now occupied for nearly thirty years. The thanks of the Society were given to Mr. Archibald Robertson, to whose exertions this change was mainly due.

In 1881 Dugald Bell published his book, "Among the Rocks round Glasgow," a most valuable little work, which, strange to say, has never had a successor on the same lines. In the death of Mr. Arthur Pratt about this time, it is interesting to note that the Society lost one

of the earliest students of the microscopic characters of rocks. His name lives after him in the fine Pratt collection of thin sections of rocks presented to the Kelvingrove Museum.

In the spring of 1883 the Society was honoured by the presentation to one of its members by the London Geological Society of the balance of the Murchison Donation Fund. Mr. John Young, of the Hunterian Museum, received this great and well-merited distinction for the value of his researches on fossil Polyzoa and his investigations into the structure of the shells of the Carboniferous Brachiopoda.

The benefits of membership were materially increased when Bailie John Farquhar presented the beautiful petrological microscope, which to the present day has been in constant use, and is still one of the most valued assets of the Society.

Dr. John Young's paper on "Cone-in-Cone Structure" in vol. vii. is noteworthy as containing the first photographic illustrations produced in our *Transactions*. Two splendid photogravures by Mr. Annan were given, which have certainly never been surpassed for accuracy and beauty of representation in any subsequent part. The modern "half-tone" process of reproducing photographs was not yet in general use. The first paper to contain half-tone illustrations was that by Mr. James Neilson "On the Calderwood Limestone and Cement-stone," published in 1896. These illustrations were not printed on the special plate paper now used, but appeared in the text. In the same volume (vol. x.) illustrations of the same kind appear in Mr. John Renwick's paper "On the Glen Fruin Moraine." Since that time they have become increasingly common, and at the present time not the least valuable part of our *Transactions* consists of the fine photographs illustrating the local geology. Photo-micrographs have only recently appeared in our pages, the first paper containing illustrations of this kind being that by Mr. J. G. Goodchild on "Desert

Conditions in Britain" (vol. xi.), illustrated by two fine collotype reproductions of micro-photographs of sands.

In 1890 the Society had the great distinction of having at its head the President of the Royal Society, the election to this office being universally considered the greatest honour that can be attained by any man of science. Congratulations were sent to Sir William Thomson, which were redoubled a year later on his accession to the peerage as Baron Kelvin. Another well-merited distinction that fell to a member of the Society about this time was the award of the degree of Doctor of Laws to Mr. John Young by Glasgow University, an event that was greeted with much enthusiasm by all who knew him.

In the autumn of 1893 Lord Kelvin retired from the office of President after having filled the position for twenty-one years. His place was taken by Sir Archibald Geikie, who has been a member of our Society since 1862. In the following year an important step was taken to make the advantages of the Society more widely known. A resolution, still in force, was then passed that students attending geological classes should be admitted to membership at a much reduced subscription. Young students of the science were also encouraged by the offer of prizes to those who passed highest in the Science and Art Examination in Geology.

In June, 1896, an interesting ceremony was held in the Bute Hall, Glasgow University, when Lord Kelvin's jubilee was celebrated by the presentation of an extraordinary number of addresses from Universities, learned societies, and public bodies all over the world. Our Society joined in doing honour to the illustrious scientist who was for so many years its President. Sir Archibald Geikie and the late James Barclay Murdoch, Esq., President and Secretary respectively, attended the ceremony and presented an address to Lord Kelvin. A fac-simile of the address was printed at the end of vol. x. of the *Transactions*.

In 1904 the study of geology in the West of Scotland

received an important impetus by the foundation of a Chair in that subject in Glasgow University. Up till this time the subject had been taught, in addition to zoology, by the Professor of Natural History. Glasgow was fortunate in securing as its first holder of the Chair of Geology Dr. J. W. Gregory, D.Sc., F.R.S., a geologist and geographer of international reputation. Professor Gregory at once joined the Glasgow Geological Society, and has since contributed valuable papers to its *Transactions*. In order to mark their appreciation of the importance of this appointment, the Society entertained Professor Gregory to a complimentary dinner in the Grand Hotel, at which numerous representatives from the University and other scientific bodies were present.

In November, 1905, Mr. J. B. Murdoch of Capelrig retired from the post of Secretary which he had so long and ably filled. Mr. Robert Crawford was commissioned by the Society to paint his portrait, but, unhappily, Mr. Murdoch died in the spring of 1906. The portrait when finished was presented to his family. For some time the Council had been considering the revisal of the constitution, and in December, 1905, an amended constitution was presented to the Society and approved. The Society was honoured in 1906 by the election of Professor Gregory, Vice-President, as President of the Geological Section of the British Association. The jubilee year of the Society has been marked by ever-increasing activity on the part of its members. Mr. Macnair, Hon. Secretary, has published two handsome volumes on "The Geology and Scenery of the Grampians," and Professor Gregory has published a valuable work on "Geography: Structural, Physical, and Comparative," while Mr. F. Mort, Hon. Secretary, has published a text-book for schools on one aspect of the same subject.

Chapter IV.

REVIEW OF FIFTY YEARS' WORK.

Physical and Dynamical Geology.

GLASGOW geologists are fortunate in the wealth of instructive illustrations of the phenomena of dynamical and physical geology within our field of study, including in the immediate neighbourhood the volcanic plateaus of the Kilpatrick Hills and Campsie Fells with the dissected volcanic necks whence the lavas were ejected, the picturesque ravines cut by the streams that fall into the Glasgow basin from the southern plateau, the canyon below the Falls of the Clyde (the best illustration of waterfall action in the British Isles), Loch Lomond with its excellent example of fiord and loch formation (now within tram ride of the city), the raised beaches in the suburbs and around the many-branched estuary, the faulted borders of the Glasgow basin and the varied deposits spread by ice over its floor; while within our range of special study as belonging to Western Scotland there are such classic geological areas as Glen Roy, with its parallel roads; the North-west Highlands, with their impressive overthrusts; the Southern Uplands at Girvan and Moffat, with their complex folds; and the Western Isles, with their shattered fragments of the Cainozoic lava plateaus that once covered a large part of the North Atlantic between the British Isles and Greenland. The *Transactions* of the Society contain a long series of valuable contributions, recording observations on these physical phenomena, and important discussions of the principles they illustrate.

Physical and Dynamical Geology.

LORD KELVIN ON DYNAMICAL GEOLOGY.

The Society had the privilege of publishing several of the papers in which Lord Kelvin announced his once unpopular views as to the limited age of the earth and his contributions to various branches of geological dynamics. It was in our *Transactions* that Lord Kelvin proclaimed his own intense personal interest in the science of geology. His first communication to the Society was his paper in 1868 on "Geological Time,"* in which he repudiated the exaggerated claims of the Huttonians for the uniformity of present geographical conditions and the practically infinite age of the earth. Lord Kelvin showed that tidal friction acts as a brake that must check the earth's rotation and so lengthen the day. The earth must once have rotated around its axis more quickly than it does now, and the centrifugal force tending to throw bodies off the earth's surface must have been correspondingly greater. Ten thousand million years ago, a period, said Lord Kelvin, "which I believe will not satisfy some geologists," the earth must have been rotating more than twice as fast as at present, and the whole condition of things on the earth would have been different. The forces that control the attack of the geographical agents upon the rocks of the earth's crust cannot, therefore, have been uniform; and he argued from the study of subterranean temperature that geological history and the existence of life on the earth must be limited within some such period as one hundred million years.

In his second paper, "Of Geological Dynamics,"† he defended his views as to the age of the earth from the onslaught on them by Professor Huxley. In a further paper‡ Lord Kelvin explained the internal condition

* W. Thomson. "On Geological Time." *Trans.*, vol. iii. pt. i., 1868, pp. 1-28.

† W. Thomson. "Of Geological Dynamics." *Trans.*, vol. iii. pt. ii., 1869, pp. 215-240.

‡ W. Thomson. "The Internal Condition of the Earth: as to Temperature, Fluidity, and Rigidity." *Trans.*, vol. vi. pt. i., 1879, pp. 38-49.

of the earth as shown by its underground temperatures and by the rigidity proved by the phenomena of the tides. He showed that the evidence of tidal action completely contradicts the once prevalent theory that the earth is a thin shell filled with molten rock; it proves, on the contrary, that the earth is almost or wholly solid.

From problems of the internal heat of the earth Lord Kelvin followed in a later paper* to consider possible former variations of climate. He discussed this subject in an address to the Society, in which he quoted evidence that trees once lived in the Arctic regions, and then showed that possible changes in the distribution of land and water in the northern hemisphere would be quite sufficient to account for the local change in climate proved by these trees. They do not render it necessary to assume any fundamental change in the climate of the globe or variation in our supply of heat.

Sir Archibald Geikie on Denudation and Geological Time.

Another valuable series of papers affecting fundamental geological principles is that by Sir Archibald Geikie on modern denudation and the origin of scenery. His memoir "On Modern Denudation"† was read in March, 1868, and published in the *Transactions* in vol. iii., pp. 153-190. It included an instructive collection of data regarding river action, much of which has been subsequently incorporated in the author's great "Text-book of Geology." He pointed out the secondary importance of marine denudation compared with that due to river action. Like Lord Kelvin, he protested against the exaggerated estimates of geological time based upon the assumed inconceivable slowness of present denudation. He pointed out that denudation at the present rate of progress would wash away all the lands of the

* W. Thomson. "Geological Climate." *Trans.*, vol. v. pt. ii., 1877, pp. 238-250. Map.

† Vol. iii. pt. i., 1868.

globe in a few million years, and that the exorbitant demands on time fashionable at that date were unnecessary.

A Modern Minor Catastrophe.

The reasonableness of this conclusion is shown by such illustrations of the occasional extreme rapidity of geological action as the account given by King* of a flood in the desert of Atacama, in Chile, when a rush of water down a dry valley nearly destroyed the railway station of Yerba Buena, swept away 300 tons of coal, and "wiped out" 9 miles of the line. The noise of the collisions between the stones being carried along in the water was so loud that the people at the station could hardly hear one another speak. Three miles down the valley below the station the slope was gentler; so first the larger stones were dropped and then the gravel. After 20 miles of devastation the flood left the railway route and flowed along another dry river bed, where it spread out and was all absorbed by the ground, as little or none of the water reached the sea.

Rock Weathering and the Age of the Earth.

A much larger estimate of the length of geological time than Lord Kelvin was willing to admit was advocated by Goodchild† from the possible rate of rock weathering. He held that the time since the Cambrian period must be reckoned in several hundred millions of years. His calculation was based on the fact that when such minerals as hornblende and augite are weathered they absorb one-third of their weight of carbonic acid, so that a cubic yard of these minerals extracts 1 ton of carbonic acid from the air. The atmosphere over each square yard of the earth's surface contains only 10 lbs.

* T. King. "Notes on a Recent Flood in the Desert of Atacama, North Chile." *Trans.*, vol. vii. pt. ii., 1885, pp. 262-263.

† J. G. Goodchild. "Geological Time" (Abstract). *Trans.*, vol. xi. pt. ii., 1900, pp. 267-268.

of carbonic acid gas. Hence rock weathering can only proceed very slowly, as it would soon exhaust all the carbonic acid in the air, and the available sources for the replenishment of this material are limited.

Post-Glacial Denudation.

The slowness of normal denudation has been emphasised by Professor James Geikie* in a valuable memoir showing the limited changes that have taken place in Scotland since Glacial times, although in one or two places the amount of post-glacial erosion shows that the lapse of time has been very great. The river Doon, below its escape from Loch Doon, has cut a gorge 100 feet deep and two-thirds of a mile long through hard rocks, such as greywackes and shales. Seventy million cubic feet of rock have been removed since Glacial times. Nevertheless, in spite of this instance of the local extent of post-glacial erosion, the author maintains that the glacial deposits upon the whole (p. 73) still retain much of the appearance they presented at the close of the marine episode in our glacial history. He claims that the broad-backed undulations of boulder clay are not forms due to post-glacial weathering, but "probably, oftener than we are aware, irregularities produced by the varying pressure and movements of the old ice sheet." He points out that, however long may have been the time since the British Islands rose above the Arctic Sea, in which the low-level marine glacial beds were laid down, yet comparatively little change has come upon the land at the instance of the atmospheric forces. "The digging out of our valleys and the shaping of our mountains was a work begun in very early geological times, and had been well-nigh completed to its present state before the advent of the Glacial epoch" (p. 74).

* J. Geikie. "On Denudation in Scotland since Glacial Times." *Trans.*, vol. iii. pt. i., 1868, pp. 54-74.

Physical and Dynamical Geology.

A British Desert.

Lord Kelvin's view that great changes in the Arctic climate have been caused by alteration in the distribution of land and water may also be used to explain former conditions of the climate in the British Isles, for that they once had an arid climate was shown in a valuable memoir by J. G. Goodchild.* He defined deserts as areas where the total quantity of aqueous vapour normally present in the air is much below the average, a definition which he advanced as an improvement on that by Sir John Murray, that deserts are districts where the annual rainfall is less than 10 inches. Goodchild described the various phenomena due to wind erosion, the characteristic form of desert sand grains, and the conditions which control the deposition of iron salts under desert conditions. He referred also to the fact that the existence of thick beds of rock salt and gypsum, and he added also of dolomite and hydrocarbons, indicate that arid climatic conditions prevailed during their deposition. He held, moreover, that the ironstaining of some British sandstones, the formation of deposits of hæmatite and dolomite, were due to similar conditions. He accordingly advocated the desert theory of the formation of the Old Red Sandstone and the Torridon Sandstone, as well as of the New Red Sandstone and Permian beds, for which this origin is generally admitted.

Sedimentation.

Of the normal phenomena of physical geology many excellent local illustrations have been described in the *Transactions*. One striking picture of former times is always available for inspection, owing to the wisdom of the municipal authorities of Partick, who have preserved in Whiteinch Park the famous fossil grove, showing the roots and lower parts of the stems of some Carboniferous

* J. G. Goodchild. "Desert Conditions in Britain." *Trans.*, vol. xi. pt. i., 1898, pp. 71-104, pl. vii.

trees. This magnificent example of a primæval forest, an illustration of which forms the frontispiece of the first volume of Seward's "Fossil Botany," has been described in the *Transactions* in a joint paper by Dr. John Young and D. C. Glen.* The trees are identified as *Lepidodendron veltheimianum* in an accompanying paper by Mr. Kidston.†

A similar fossil forest has been described by E. A. Wünsch‡ in the volcanic tuffs of Lower Carboniferous age in north-eastern Arran; there tree stems *in situ* mark the position of two successive forests.

The fine sections in the local Carboniferous rocks have been used to illustrate the relations of unconformity to local contemporary erosion by Professor John Young and Dr. John Young.§ The sections in the Carboniferous Limestone series at Bishopbriggs Quarry show a break in the succession, which may be due to a local elevation producing a true unconformity or to a change in the currents causing the erosion of beds that had only recently been deposited. Professor Young and Dr. Young concluded that in that particular instance the break in the strata was probably due to an uplift; but they admit that adjacent evidence in the Coltpark Quarry shows that contemporaneous erosion might explain the occurrence without the assumption of so great a displacement as they accepted.

A geologist in his study may not be expected to contribute much to knowledge of the actual distribution of deep-sea deposits; but one of the distinguished early

* J. Young and D. C. Glen. "Notes on a Section of Carboniferous Strata, containing Erect Stems of Fossil Trees and Beds of Intrusive Dolerite, in the old Whinstone Quarry, Victoria Park, Lower Balshagray, near Whiteinch and Partick." *Trans.*, vol. viii. pt. ii., 1888, pp. 227-235, pl. iv.

† R. Kidston. "Note on the Nature of the Fossil Trees found at Whiteinch." *Trans.*, vol. viii. pt. ii., 1888, pp. 235-236.

‡ E. A. Wünsch. "On the Occurrence of Fossil Trees imbedded in Trappean Ash in Arran" (Abstract). *Trans.*, vol. ii. pt. ii., 1866, pp. 97-99.

§ J. and J. Young. "Local Unconformity as shewn in Sections at Bishopbriggs." *Trans.*, vol. ii. pt. iii., 1867, pp. 283-291, pl. iv.

members of the Society, David Robertson, the naturalist of Cumbrae, used some interesting laboratory experiments to elucidate the distribution of sediments on the ocean floors.* He showed that fine silt remains suspended in fresh water for a prolonged period. In his experiments silt floated in abundance for three weeks, while the water was still tinged with colour at the end of six months. But similar silt in sea water is promptly precipitated. Hence sediments carried into the sea by rivers are necessarily deposited near the shore, leaving no material of continental origin for the formation of deposits in the central oceans. This fact is now well known from the detailed observations on the subject in the famous "Challenger" Report on Deep-sea Deposits, and by the experiments of the staff on that expedition; but Robertson's researches have been often overlooked.

Raised Beaches and Earth Movements.

The raised beaches of the western coasts of Scotland have been repeatedly described in the *Transactions*, as in a paper by John Dougall on "Ancient Sea Margins around Glasgow," which is an especially valuable record, as most of his illustrations are drawn from the site of the city where the evidence is now destroyed. He describes a series of sea beaches ranging from one 20 feet above sea-level at the Saltmarket, to others at the height of about 180 feet on Observatory Hill, in Hillhead, on the Springburn Road, and in Langside.

Ancient beach lines inevitably recall the famous parallel roads of Glen Roy, which are of tectonic interest from their bearing on Pleistocene earth movements in Scotland. They have been well described in the *Transactions* by Mr. William Jolly in a paper,† and also in his valuable detailed guide to their topography in an

* D. Robertson. "Note on the Precipitation of Clay in Fresh and Salt Water." *Trans.*, vol. iv. pt. iii., 1874, pp. 257-259.

† W. Jolly. "The Parallel Roads of Lochaber. The Problem, its Conditions and Solutions" (Summary). *Trans.*, vol. viii. pt. i., 1886, pp. 40-47.

account of an excursion* of the Society to Glen Roy. In recent years Mr. Colin Livingstone, of Fort-William, in a paper published in vol. xii., part iii., pp. 326-353, has attacked the usually accepted theory of the formation of the parallel roads, and explains them as due to terraces along the edges of glaciers, and not along the shores of lakes.

Whether raised beaches were due to movements of the land or of the sea is a problem of widespread geological interest, and a once favourite theory attributed the rise and fall of sea-level to decrease and increase of polar ice caps. The theory was discussed in a paper by Lord Kelvin,† in which he concludes that the reduction in thickness of the Antarctic ice-cap by 400 feet would raise the sea-level all over the world by 10 feet.

Old River Channels.

Relics of former river systems are described in various papers, as by Mr. R. Dunlop,‡ in which he described a "wash-out" in the coal near Airdrie forming a channel with a boulder deposit probably of Glacial age, though the clay which formed the base of the conglomerate was a fireclay, and not an ordinary boulder clay.

The pre-glacial buried channel of the Kelvin river was described in a valuable paper by Bennie,§ in which he showed that under the plains between Clydebank and Cadder a former channel of the Kelvin is buried at the depth beneath Garscadden House, for example, of 376 feet. At Millichin the depth is 355 feet, and the old land surface lies 221 feet beneath the present sea-level.

* W. Jolly. "The Joint Excursion of the Edinburgh and Glasgow Geological Societies to Ben Nevis and the Parallel Roads of Lochaber, in July, 1885." *Trans.*, vol. viii. pt. i., 1886, pp. 72-105.

† W. Thomson. "Polar Ice-caps and their Influence in Changing Sea Levels." *Trans.*, vol. viii. pt. ii., 1888, pp. 322-340.

‡ R. Dunlop. "Note on a 'Wash-out' in a Shallow Pit of the Drumshangie Coal Company, near Airdrie." *Trans.*, vol. ix. pt. ii., 1893, p. 320.

§ J. Bennie. "On the Surface Geology of the District round Glasgow, as indicated by the Journals of certain Bores." *Trans.*, vol. iii. pt. i., 1868, pp. 123-148.

The outlet of this channel has not yet been conclusively established; but apparently the Kelvin must have discharged to the sea through a deep canyon under the present outlet of the Clyde between Bowling and the shore of Renfrewshire.

Some interesting dry river channels at Muirkirk were described by Mr. John Smith,* illustrated by a photograph of a model made by Mr. R. Dunlop; the authors thus directed attention to examples of river capture and valley beheading before the study of that subject had become so popular in this country as it has been in the past ten years.

The problems of variations in river courses have also been illustrated in a paper by Mr. Stark† describing changes in the course of the Clyde and its tributaries near the Falls at Lanark. The general geology of the Falls was described in an early paper by J. Dougall.‡ Mr. Stark has indicated the probably pre-glacial position of the river channels. The Clyde from Corra Linn to Bonnington Falls flows in a young, narrow gorge, while the former channels of the river were wide valleys, now dry and filled by glacial drifts; these soft deposits are more readily washed away, and are thus being worn into wide valleys by the streams in them. The probable pre-glacial courses of the Clyde and its tributaries near Lanark are shown in Mr. Stark's sketch map.§ Mr. Stark concludes that if the Bonnington gorge has been cut back at the rate of 1 foot in twenty years, the close of the glacial period in the area would have been about 80,000 years ago, and this date for the end of the Glacial period is quoted by Mr. Stark, owing to its agreement with Croll's estimate.

* J. Smith. "Dry River Channels in the Neighbourhood of Muirkirk." *Trans.*, vol. x. pt. ii., 1896, pp. 331-333.

† J. Stark. "The Surface Geology of the Falls of Clyde District." *Trans.*, vol. xii. pt. i., 1899, pp. 52-57, pl. iii.

‡ J. Dougall. "Sketch of the Geology of the Falls of Clyde the Mouse Valley, and Cartland Crags." *Trans.*, vol. iii. pt. i., 1868, pp. 44-53.

§ *Op. cit.* pl. iii.

Faults.

Fault action is magnificently displayed in the Glasgow basin, and attention has been frequently called to the direct effect of faults upon the present geography of the country. Thus, Dr. John Young* describes a fault in Dumbuck Glen, near Dumbarton, and its effect on the present geography of the Kilpatrick Hills.

The great Highland boundary fault is more familiar to us in our excursions than in the pages of the *Transactions*, but an account of part of its course in Arran has been given by Mr. J. Stark.†

A small reverse fault, with a throw of 2 feet, but noteworthy, as such are rare in our coalfields, has been described by R. M'Laren, from Drumshangie.‡

Local Earthquakes.

Earthquake phenomena have, unfortunately, received but slight notice from the Society, although numerous earthquakes have been recorded along both the boundary faults of the Glasgow basin. The house at Mearns of J. B. Murdoch, so long the honoured Secretary of the Society, stands close beside the southern boundary fault, and he felt there the Yorkshire earthquake of 1905, apparently the only record of it in Scotland. The only paper in the *Transactions* on Scotch earthquakes is one written by James Bryce§ (the father of the present Ambassador to the United States). He expressed in it the interesting hope that the "late extraordinary discoveries of fossils in Canada" would be followed by

* J. Young. "On the Occurrence of a Fault in the Old Red Sandstone and Ballagan Series in Dumbuck Glen, near Dumbarton." *Trans.*, vol. ii. pt. iii., 1867, pp. 257-259.

† J. Stark. "The Highland Boundary Fault in Arran" (Summary). *Trans.*, vol. xii. pt. iii., 1906, pp. 292-293.

‡ R. M'Laren. "A Reverse Fault in Kiltongue Coal at Drumshangie Colliery." *Trans.*, vol. ix. pt. ii., 1893, pp. 390-391.

§ J. Bryce. "Notes on the Earthquake District of the County of Perth." *Trans.*, vol. ii. pt. i., 1865, pp. 70-71.

carrying the horizon of life down to the central granite. This view, based on the supposed organic nature of Eozoon, is, however, of less permanent interest than Bryce's statement as to the structure of the Grampians. According to Bryce, "in regard to the Grampians, whatever that term may be taken to mean, there is no such thing to be seen as an axis, either in a geological or geographical sense, within the great primary tract in question; that there is no continuous ridge, or plateau, and no watershed; and that, while the true limits of the region lie between Galway Bay, in Connemara, on the south-west, and the Moray Firth on the north-east—precisely the same succession of rocks, with like mineral character and disposition of the masses occurring through this whole extent—it presents nothing resembling a mountain chain in the sense in which geographers use that term. This immense tract, as now marked out of one physical structure and aspect, is the earthquake region of Scotland and Ireland, and its prolongation north-east, beneath the shallow waters of the German Ocean, would bring us into Scandinavia,"* where, he continues, the country is still being uplifted.

Volcanic Geology.

The general treatment of the volcanic rocks is undertaken in the chapters on stratigraphical geology and on petrology, but a brief reference may be made to those accounts of volcanoes which adduce illustrations of the dynamics of volcanic action, such as Dr. Horne's paper on the Old Red Sandstone volcanoes north of the Grampians.† There are also accounts of the volcanic rocks by Pratt at Kilmacolm,‡ and of the volcanic rocks at Dalry

* J. Bryce. "Notes on the Earthquake District of the County of Perth." *Trans.*, vol. ii. pt. i., 1865, pp. 70-71.

† J. Horne. "The Volcanic History of the Old Red Sandstone Period North of the Grampians" (Abstract). *Trans.*, vol. vii. pt. i., 1883, pp. 77-81.

‡ A. Pratt. "Notes on the Igneous Rocks of the Kilmalcolm District." *Trans.*, vol. vii. pt. i., 1883, pp. 46-49.

by Craig.* The latter describes an interesting case of the sudden stoppage of the formation of a bed of limestone by an eruption of volcanic ash and of the association of ash beds with black-band ironstone.

A Carboniferous ironstone that has been ascribed directly to volcanic action occurs at Stevenston and Dalry, for Mr. John Smith attributes it to a rain of an ironstone powder discharged into the air as volcanic dust.†

Passing to the Cainozoic volcanoes, the Scuir of Eigg, with the interpretation of its structure advanced by Sir Archibald Geikie, was described by Mr. Henry Taylor.‡ The Cainozoic volcanic rocks of the Western Isles may be the source of the pumice found by Mr. J. Smith, who has presented geologists with many perplexing problems, in the 25-foot beach of the south-western coasts of Scotland.§ He has obtained precise descriptions of the material from various petrologists, but his discussion of the source of this pumice leaves its origin perhaps still somewhat uncertain.

An account of the Cainozoic volcanoes of Germany in the Eifel and at Hohentwiel, near Wurtemberg, have been given by J. C. Christie.||

A Solution Theory of Igneous Intrusions.

Contributions to knowledge of the intrusive igneous rocks, which are such an important feature in the geology of the Glasgow basin, are recorded in the chapter on petrology, but the processes of their intrusion are essen-

* R. Craig. "Volcanic Disturbance of the Ironstone Measures in the vicinity of Dalry during the Carboniferous Period." *Trans.*, vol. vii. pt. ii., 1885, pp. 233-237.

† J. Smith. "On a Bed of Ironstone occurring in Trap Tuff in the Parishes of Stevenston, Dalry, and Kilwinning." *Trans.*, vol. x. pt. i., 1895, pp. 133-136.

‡ H. Taylor. "Notes on the Geology of the Island of Eigg." *Trans.*, vol. xi. pt. i., 1898, pp. 32-40, pl. iii.

§ J. Smith. "On the Occurrence of Pumice Pebbles in the Raised Beaches of Ayrshire." *Trans.*, vol. x. pt. ii., 1896, pp. 349-353.

|| J. C. Christie. "A Visit to the Eifel and its Volcanic Rocks." *Trans.*, vol. vi. pt. ii., 1882, pp. 192-205.

tially dynamical. Hence reference should be made here to the interesting paper by the late J. G. Goodchild, of which, unfortunately, only a summary was published.* Many geologists have noticed the fact that intrusive igneous rocks appear to have completely replaced pre-existing sediments, and not merely to have pushed them aside. Mr. Goodchild explains such cases, which he regards as far more frequent than is generally recognised, by the intrusive rock having slowly eaten its way into the pre-existing rocks by a process of solution, instead of being mechanically injected into a space formed by wrenching the rocks apart.

Granite and Mountain Structure.

In a paper on the origin of granite by James Anderson,† the author advances difficulties in the view that the granite of Arran was injected in a freely molten condition, and he concludes that the great displacements seen in the border of granitic masses is due to the sliding downward of the surrounding rocks, while the granite remained passive. This conception of mountain structure, as due to the crumpling and folding of rocks as they slip slowly down the slopes around a plutonic intrusion, is an old theory, which has been re-advocated as explaining the origin of many mountain chains in a well-known work by Reyer.

The North-west Highlands.

In the tectonic geology of Scotland the great movements of the north-western Highlands would naturally have been expected to attract the constant attention of the Society. Possibly because they are so far to the north-west very little has been written upon the subject

* J. G. Goodchild. "On the Modes of Occurrence and the Origins of Intrusive Rocks, with some remarks upon the Formation of Eruptive Rocks in General" (Summary). *Trans.*, vol. xii. pt. iii., 1906, pp. 305-307.

† J. Anderson. "The Origin of Granite" (Summary). *Trans.*, vol. xii. pt. ii., 1905, pp. 236-238.

in the *Transactions*. There is a short note by H. W. Crosskey,* which simply affirms the author's acceptance of Sir Roderick Murchison's view. A second communication on the subject by Mr. James White† is of interest from his acceptance of Sir Archibald Geikie's view of glacial action in Scotland in Cambrian times. The evidence on this subject at Gairloch has not usually been regarded as wholly convincing, but the conclusion is significant, as Cambrian glaciations have now been established in South Australia and in China.

The Origin of Some Rock Structures.

The solution offered by Teall's work in the north-west of Scotland as to the origin of basic schists by dynamic metamorphism has been applied in the Southern Highlands by Macnair, who thus explains the origin of the hornblende schists associated with the Loch Tay limestone.‡

An early general description of metamorphism, interesting as a statement of the views commonly held in 1864, was given by Dr. A. T. MacHattie.§

The formation of the rock structures known as Cone-in-Cone and columnar jointing in basalt have been frequently discussed before the Society. The Cone-in-Cone structure was described in a memoir by Dr. John Young,‖ and he explained it as due to the gases given off by decomposing organic matter rising slowly through soft mud. This theory, however, has not gained general acceptance.

* H. W. Crosskey. "On a Section near Inch-na-Damff, Sutherlandshire." *Trans.*, vol. ii. pt. i., 1865, p. 19.

† J. White. "Notes on Gairloch, Ross-shire." *Trans.*, vol. ix. pt. i., 1891, pp. 192-200.

‡ P. Macnair. "On the Altered Basic Rocks of the Highlands, as exemplified by the Sill of Hornblende Schist underlying the Loch Tay Limestone." *Trans.*, vol. x. pt. ii., 1896, pp. 302-317, pl. vi.

§ A. T. MacHattie. "Lecture on Metamorphism, with Special Reference to Chemical Changes in Rocks." *Trans.*, vol. ii. pt. i., 1865, pp. 20-27.

‖ J. Young. Notes on Cone-in-Cone Structure." *Trans.*, vol. viii. pt. i., 1886, pp. 1-27, pl. i.-ii.

A similar explanation of the cause of columnar jointing in basalt has been advanced by J. Wallace.* This view was advanced in spite of the masterly exposition of columnar jointing by James Thomson.† His paper showed that the theory of shrinkage explains not only the jointing into hexagonal columns, but also the formation of the more puzzling ball-and-socket structure by which the columns are broken up into blocks by curved horizontal joints. These joints Thomson explained as cracks beginning in the centre of the column and gradually spreading to the margin; as the growing fracture traverses a nearly homogeneous material, it is naturally conchoidal. The course of the fracture is broken where it comes to the edges of the column, and thus the angles are left projecting upward and fitting into notches in the block above. An interesting development of columnar structure in sandstone, also due to shrinkage, has been described by D. C. Glen.‡

Plutonic Petroleum.

The important contributions of economic geology to geological principles have not been extensively quoted in the *Transactions*. Mr. R. Anderson§ has discussed the origin of petroleum, and subsequently Dr. J. R. M. Robertson|| gave a valuable account of the oil wells of Burma, and their evidence as to the origin of petroleum. He rejects the view that petroleum is due to the underground distillation of lignitiferous or carboniferous de-

* J. Wallace. "A Theory of the Origin of Columnar Structure as Illustrative of Sections near Glasgow." *Trans.*, vol. xii. pt. ii., 1905, pp. 234-235.

† J. Thomson. "On the Jointed Prismatic Structure in Basaltic Rocks" (Abstract). *Trans.*, vol. vi. pt. i., 1879, pp. 95-110, pl. ii.-iv.

‡ D. C. Glen. "Notes from the Island of Bute—On a Tract of Columnar Sandstone near Kilchattan." *Trans.*, vol. v. pt. i., 1875, pp. 154-157.

§ R. Anderson. "On the Origin of Petroleum." *Trans.*, vol. iv. pt. ii., 1873, pp. 174-177.

|| J. R. M. Robertson. "The Oils and Oil-Wells of Burma, with Notes on the Geology of the Districts of their Occurrence." *Trans.*, vol. vi. pt. ii., 1882, pp. 226-247, pl. vii.

posits, because petroleum is not usually found associated with rocks of the Carboniferous age, where the chief carbonaceous deposits of the world occur. Petroleum is, on the contrary, generally associated with Middle Cainozoic strata. He therefore attributed petroleum to some chemical reactions confined to special areas where, however, they "are in continual operation, elaborating the oil from hour to hour and from day to day at a constant and regular rate of production" (p. 247). This theory promised petroleum wells a permanent supply; but later experience has not supported it, and Dr. Robertson offered no explanation of the source of the hydrocarbons or why they should be confined to such limited areas. Most modern authorities on oil would, however, agree that the author was right in not necessarily deriving petroleum from ordinary coal or lignite; for it appears to be often distilled from other forms of organic matter, and its distribution in Europe and Asia in rocks of Middle Cainozoic age is due to the great earth movements connected with the formation of the Alpine-Himalayan mountain system, along the line of which so many oil fields occur.

Chapter V.

REVIEW OF FIFTY YEARS' WORK—

Continued.

Mineralogy and Petrology.

ALTHOUGH the work of the Society during the past fifty years has been largely stratigraphical and Palæontological, the chemical, petrological, and mineralogical side of the science has not been neglected. In looking over the published *Transactions* it is surprising how much has been done; names of fifty members could be given who have contributed to this work.

Amongst the early chemical papers was one on "Metamorphism, with Special Reference to Chemical Changes in Rock," by Dr. A. T. MacHattie, F.C.S. (see vol. ii., p. 20, 1864). This was followed by over a dozen papers by Mr. J. Wallace Young dealing with the chemistry of rocks and minerals. His first paper is "On the Analysis of a Red Mineral from the Renfrewshire Hills," first noticed by Mr. John Young. From the analysis this mineral was named Ferrite. Other papers were "On the Presence of Magnesia in Rocks and the Formation of Dolomite," and "A Green Fibrous Mineral resembling Baltimorite in Trap round Glasgow." No name was given to this mineral, but from the description it is a variety of Saponite, afterwards known as Bowlingite. He had also a paper on a similar mineral from Cathkin. This is probably the variety of Saponite named Cathkinite. A very important paper is one "On the Chemistry of Some Carboniferous and Old Red Sandstones." This paper deals chiefly with the nature of the cementing material. These papers will be found in vols. ii. and iii. of the *Transactions*. A number of his analyses have found their

way into the standard mineralogical works of the present time.

Amongst other workers on the chemical side may be mentioned Mr. J. B. Hannah, Dr. James J. Dobbie (now Director of the Royal Scottish Museum, Edinburgh), and Mr. G. G. Henderson (now Professor of Chemistry in the Technical College).

Amongst the early workers in the field of petrology we have Mr. R. Whyte Skipsey, who dealt specially with the igneous rocks. There may be noted his papers on the "Igneous Rocks of the Cathkin Hills" and on the "Igneous Rock Sections at the Rye Water, Ayrshire." His papers are to be found in vol. ii. of the *Transactions* from 1865 to 1867. There are no very exhaustive papers on the subject in the early years of the Society, but there are quite a number of contributors. In 1864 Dr. Bryce read a paper "On the Age of Certain Trap Rocks in the Neighbourhood of Glasgow." In 1871 Mr. Dugald Bell read a note "On the Pitchstone at Corriegills." Mr. John Young was a constant contributor from the early days of the Society until his death; amongst his papers may be mentioned "Slaty Cleavage," 1877, and "Dolerites, Basalts, and Other Igneous Rocks of the West of Scotland," 1878. A very carefully prepared and beautifully illustrated paper is that "On Cone-in-Cone Structure," in which he propounded a theory for the formation of this structure, which may be briefly stated "as due to the upward and successive escape of gases generated in the lower portion of the stratum in which the structure is found." This paper was read in 1885 (see vol. viii., p. 1). In 1890 he described specimens of an ultrabasic rock belonging to the peridotite group, from Mugdock. In conjunction with Mr. D. C. Glen, quite a number of papers were read to the Society. We may mention the following:—"Notes on the Spherulitic Rock of Corriegills and the Banded Pitchstone of Invercloy, Arran," 1884; "The Cathkin Osmond Stone," 1884; "The Intrusive Dolerite at Whiteinch," 1888; and "White Dolerite

from Garngad," 1889. Mr. Glen also read papers by himself (see vol. v., p. 154) "On a Tract of Columnar Sandstone near Kilchattan, Bute," and also "On a Magnetic Sand from Rothesay," 1873.

There is in vol. v., p. 25, a very interesting illustrated paper "On the Microscopical Structure of Red Quartz-porphyry from the Old Red Sandstone of Logan Water," by the then Director of the Geological Society of Ireland, Mr. Edward Hull, M.A., F.R.S. (1873).

Professor James Thomson contributed to the Society two very interesting papers, viz., "On Jointed Prismatic Structure in Basaltic Rocks," 1877, and "On Crystallisation and Liquefaction as Influenced by Stresses in the Crystals, with Special Reference to Metamorphic Changes in Rocks, and to Plasticity of Ice," 1886.

Special mention must be made of the work of Mr. Arthur Pratt. He was the first member of the Society to make a large number of rock sections for the microscope. The slides he made are now in the Art Galleries and Museum, Kelvingrove. From this may be dated the greater interest taken by the Society in microscopical petrology. Mr. Pratt read two important papers, one "Scottish Trap Rocks and their Structure under the Microscope," 1878, and the other "On the Igneous Rocks of the Kilmacolm District," 1880.

The work of the Society in petrology was naturally chiefly confined to the rocks around Glasgow, but the members had occasionally the pleasure of having a description of rocks from other countries; in 1878 and 1880 Mr. James C. Christie contributed three papers. The first was "A Visit to the Eifel, and its Volcanic Rocks." The other two were "Notes on the Hohentwiel, a Volcanic Cone in the South of Wurtemberg," and "On Basalt from the Siebengebirge, on the Rhine."

Mr. Robert Craig's work for the Society was palæontological, and will be noted in another part of this publication; his papers on petrology may be noted here. In 1882 he read a paper on "Volcanic Disturbances of

the Ironstone Measures in the Vicinity of Dalry during the Carboniferous Period," and in 1894 an important paper entitled "Remarks upon 'Joints' or Natural Fractures in Limestone."

Two important papers were contributed by the present Director of the Geological Survey of Scotland, Dr. Horne, in 1881 "The Volcanic History of the Old Red Sandstone Period north of the Grampians," and in 1883 "The Geology of the Isle of Man."

Dr. John R. S. Hunter, afterwards Dr. Hunter-Selkirk, read in 1884 a long paper on "The Silurian District of the Leadhills and Wanlockhead, and their Early and Recent Mining History." This paper contains a long list of the minerals from that district, which will be noticed further on.

No worker in geology during the last forty years has done more for the science than Mr. John Smith, but here we can only refer briefly to his petrological work. A great many geologists of note have written upon the geology of the Island of Arran. Mr. Smith, in prefacing his paper, "A New View of the Arran Granite Mountains," describes the island as

> This little world,
> This precious stone set in the silver sea.

Mr. Smith spent two years tackling the problem. The paper is illustrated by a map and twenty-two illustrations drawn by the author; it may certainly be regarded as one of the most valuable contributions to the geology of the island (see vol. x., p. 216, 1885). Another valuable paper by Mr. Smith, read in 1898 (vol. xi., p. 238), was "The 'China-clay' Mine and the Water of Ayr Honestone Bed at Troon." Mr. Smith shows that this famous honestone is dust from a volcanic vent and deposited in water. Other papers of his are "Spango Granite," 1899; "On a Flexed Structure in the Pitchstones of Corriegills, Arran," 1900; "On Drawn-out Spherulitic (?) Structure in a Trap Dyke near Balloch Pier, Great Cumbrae"; "On Globular Structure in a Trap Rock near Neilston,

Renfrewshire." These last three will be found in vol. xii., p. 62, 1900. In 1904 he read a paper on "Trap Sills." This paper has not been published in full.

Mr. Peter Macnair, F.R.S.E., F.G.S., has since 1896 contributed many petrological papers to the Society. His first paper is "On the Altered Basic Rocks of the Highlands as Exemplified by the Sill of Hornblende Schist underlying the Loch Tay Limestone" (see vol. x., p. 302). In 1901 he read a paper entitled "Notes upon the Development of 'Ausweichung' or Strain-slip in Schistose Rocks." A summary only of this paper was published. We need not here refer to all his papers; they will be found in the recently published *Transactions* of the Society. We may refer to one read last session (1908), "Notes on an Ocellar Dolerite from Craigie Hill, Ayrshire."

Mr. Frederick Mort, M.A., B.Sc., F.G.S., has also given the Society a number of valuable papers; we can only give the titles—"The Structure of Igneous Rocks," 1904; "The Crystallisation of Rocks," 1905; "The Extension Westwards of the Necropolis Intrusion," 1906; and "The Passage of a Dolerite into a Hornblende Schist," 1908.

It is gratifying to note that there are other young members of the Society well equipped with the most modern methods coming forward to carry on the petrological work, amongst them—Mr. G. W. Tyrrell, who read a paper in 1907 "On a Section of Basalt from Dunglass Hill, with Large Crystals of Felspar, &c.," and Mr. R. Boyle, B.Sc., who read, in 1908, a paper "On the Occurrence of Ultrabasic Rocks in the Igneous Intrusions of the Lugar and Cumnock District."

The Society has had brought before it during the last fifty years a great deal of matter dealing with mineralogy. This has been chiefly in the exhibition of specimens of minerals new to the West of Scotland, or new localities for those already known. Mr. John Young did a great deal in bringing forward specimens or describing those that were brought forward

by other members. In his first paper to the Society, "The Geology of the Campsie District," he refers to two varieties of Gypsum in the section at Ballagan. He was the first to notice the red mineral from Gleniffer, which was analysed by Mr. Wallace Young and named Ferrite. He read a paper "On a New Scottish Mineral (Bowlingite)" (vol. vi., p. 58); this was analysed by Mr. J. B. Hannah. He exhibited and described specimens of Ozokerite and Urpethite, minerals belonging to the Hydrocarbons sent by Mr. John Smith, and new to Western Scotland. In vol. viii., p. 278, will be found a good paper on "Quartz as a Rock-forming Mineral." He also read "A Note upon a Peculiar Variety of Sphærosiderite from the South Hill of Campsie." This discovery, important in itself as a mineral, adds interest to another branch of geology, as this mineral has since been found in the boulder clays at Scotstoun by Mr. Mort, and by Mr. R. A. Paton at Mount Florida, affording additional evidence of the direction of the flow of the ice sheet. Another mineral which he exhibited and described was Pectolite, from Auchenstarry Quarry. This does not exhaust his contributions to mineralogy, as a great many others will be found in the first twelve volumes of the Society's *Transactions*.

In vol. iii., p. 28, under the heading of "Miscellaneous Notes on Chemical Geology," by J. Wallace Young, will be found a number of minerals described and analysed by him, including a Foliated Chlorite from St. Catherine's, Loch Fyne; Sulphide of Zinc, from Fairlie, Ayrshire (this was first observed by Mr. E. A. Wünsch); and Laumontite, from the water aqueduct near Mugdock. He also describes some of the minerals from the intrusive Felsite at Gourock; and Sulphate of Barium in thin plates, from a greenstone quarry near Carntyne.

Mr. D. C. Glen did much to interest the Society in mineralogy from his splendid collection. He was ever ready to bring before the members some of the rarer minerals, such as the Geodes of Chalcedony containing water, crystals of Greenockite, and many others.

Mineralogy and Petrology.

Dr. John R. S. Hunter, in his paper on "Leadhills and Wanlockhead" (vol. vii., p. 373), describes the mode of occurrence, and gives a list of forty-seven different minerals found in that locality.

The Society had from time to time papers from the well-known mineralogist, Dr. Forster Heddle. His chief papers are "On the Rarer Western Scottish Minerals, including Edingtonite, Greenockite, Thomsonite, and Heulandite, &c." (vol. viii., p. 196); "On New Localities for Zeolites" (vol. ix., p. 72); "On the Structure of Agates" (vol. xi., p. 152); and "The Mineralogy of the Faröe Islands" (vol. xii., p. 1). The last two papers were published after his death.

The late Mr. J. G. Goodchild, who edited Heddle's "Mineralogy of Scotland," read a paper to the Society on "The Natural History of Scottish Zeolites and their Allies" in 1903, which he considerably extended, and which was published as a supplement to vol. xii. of the *Transactions*. This paper will rank as one of the best on the subject read before this or any other Society. This paper contains a list of the localities for Scottish Zeolites by Mr. James Currie, F.R.S.E.

Mr. John Smith has done much to increase our knowledge of the minerals of the West of Scotland. We have already mentioned his discovery of Ozokerite and Urpethite, described by Mr. Young; another of these hydrocarbons he discovered near Kilmarnock and the Misk pit at Stevenston, namely, Middletonite, a fossil amber in which were included fossil microscopic plants. Amongst other minerals exhibited by him are an ore of antimony (Kermisite) from Hare Hill, New Cumnock; Chonicrite, from Bowertrapping and Colmonell; minute perfect crystals of quartz in a sooty coal at Sevenacres, Kilwinning; and crystallised Carbonite, a mineral new to the Scottish Carboniferous rocks from the same locality. Of his mineralogical papers, mention may be made of his paper on "Charred Coal, with Graphite, and Discovery of Diamonds in the Graphite at Craigman,

New Cumnock" (vol. x., p. 257), and one "On the Barite Veins of South-West Scotland" (vol. xi., p. 232), and recently he exhibited a new dolomitic mineral, "Teruelite," from the Heads of Ayr.

Mr. Walter Burns discovered a chocolate-brown variety of Saponite (Cathkinite) in the dolerite quarry at Cathkin. This mineral was described and an analysis given of it by Dr. J. J. Dobbie (vol. vii., p. 212). Dr. Dobbie also contributed other interesting mineralogical papers.

Mr. Thomas Scott read a paper on "The Geology of the District about Tarbert, Loch Fyne" (vol. viii., p. 262), in which he mentions three minerals and gives analysis of some of them. The minerals are Ankerite, Ferocalcite, and Menaccanite. Another important paper is by Mr. Robert S. Houston on "Rare Renfrewshire Minerals" (vol. xii., p. 354). This paper gives an account of the rarer minerals found in that county, with analyses of a number of them.

We have given the more important papers on mineralogy, but we may still refer to exhibits of some of interest and those recorded for the first time.

Mr. James Coutts exhibited specimens of Black Amber, a jet-like mineral from the oil shales of West Calder; Mr. Robert Dunlop, specimens of Native Paraffin from the Airdrie coalfield; Mr. A. B. Motherwell, Strontianite, from Argyleshire; Mr. James Neilson, minerals from the Little Cumbrae and Bowling; Mr. Joseph Sommerville, microscopic quartz crystals having double terminations, from Carbonite, near Paisley: Mr. William Armour, Celestite, from the Ballagan beds of Murroch and Auchenreoch Glens; Mr. R. W. Dron, Anthracite, from Provanhall; Mr. John Renwick and Mr. E. W. Gemmell, those peculiar crystals of Pseudo-gaylussite dredged from the Clyde opposite Cardross.

From the foregoing it will be seen that the subject of mineralogy has not been neglected by the Society.

Chapter VI.

REVIEW OF FIFTY YEARS' WORK—
Continued.

Stratigraphical Geology.

CRYSTALLINE SCHISTS OF THE HIGHLANDS.

IT has already been pointed out that the Clyde Valley traverses from its source to the sea the three great geological divisions of Scotland, namely, the crystalline schists of the Highlands, the later Palæozoic rocks, or Deutozoic rocks, of the Midland Valley, and the Ordovician and Silurian rocks of the Southern Uplands.

Very little work has been done by the members of the Society among the crystalline schists of the Highlands, the principal reasons for this being the exceedingly complex structure of the ground and the fact that few of the earlier members were able to work at the microscopic examination of these rocks. It will also be remembered that Murchison and Geikie had described certain sections along the margin of the Southern Highlands with reference to the supposed succession of the rocks in north-west Sutherlandshire. They believed that the Southern and Central Highlands were overlaid by a great series of quartzites, limestones, and schists, the representatives of those found in the north-west, and that they always bore the same relative position to one another, namely, the quartzites at the base, followed by limestones, and the whole overlaid by schists supposed to be of Silurian age. Notwithstanding the opposition to this hypothetical succession advanced by James Nicol, it continued to be accepted for a long period by many of the leading Scottish geologists, and there can be no doubt that it considerably hindered any advance in the study of these rocks.

In 1860 Jamieson described the schists of the Firth of Clyde, and correlated the argillaceous series of Bute with that of Loch Fyne, which he states arches over into an anticlinal axis, the more arenaceous rocks of Cowal forming the core of the anticline at Ben Capuill, near Tighnabruaich. This is believed to be a true anticline of the bedding. The altered basic rocks he calls greenstones, and points out their intrusive origin.

In a paper contributed to the Society in 1867, and published in the *Transactions*, Sir A. Geikie deals with the succession among the Silurian rocks of Scotland.* In this paper he advances a theory of the sequence and structure of the rocks just referred to, and says, "From the basement rocks the Lower Silurian quartz rocks and overlying schists undulate over the whole of the rest of the Highland region. They are disposed in wave-like folds, whereby the lower quartz rocks and limestones are from time to time brought to the surface as we follow them southwards to the Highland border." In the various maps of Scotland published by Sir A. Geikie, and in the map accompanying the "Catalogue of the Western Scottish Fossils," published as a local guide book for the use of the members of the British Association, at the meeting held in Glasgow in 1876, the crystalline schists of the Firth of Clyde are mapped as being of Lower Silurian age, the same structure and succession being adopted as that worked out by Jamieson.

Mr. James Thomson contributed an important paper to the Society in 1875 upon "The Geology of the Island of Islay."† In this paper he pointed out for the first time that the Rhinns of Islay consist of Laurentian (Lewisian) gneiss. He showed the difference between the rocks that form the centre of the island and the gneiss of the Rhinns, and pointed out that they belong to two widely different periods in geological time. He also compared in detail the gneiss of the Rhinns with the fundamental gneiss of the Hebrides and Sutherland.

* *Trans.*, vol. iii., p. 75. † *Trans.*, vol. v., p. 200.

The metamorphic rocks of the remaining portion of Islay are referred by him to three different periods. The strata seen along the west side of the Sound of Islay from Bonhaven Bay to Lossit he regarded as of Lower Cambrian (Torridonian) age. These include the dolomitic shales, flags, quartzites, and Port Askaig conglomerate of the Geological Survey. The quartzite and underlying slates of the south-eastern belt he considered to be of Upper Cambrian (Torridonian) age. The quartzite seen in the Mull of Oa, with the Port Ellen phyllites, were regarded as belonging to the lower members of the Lower Silurian rocks of the Highlands. It will thus be seen that the recent work of the Geological Survey in Islay had been anticipated to some extent by Thomson.

In 1878 Dr. James Geikie contributed a paper entitled "Notes on the Geology of Colonsay and Oronsay,"* and in this paper the current views regarding the structure of the Highlands are advanced in connection with these islands.

In 1896 Mr. Peter Macnair contributed a paper dealing with the altered basic rocks of the Highlands, as exemplified by the sill of hornblende schist underlying the Loch Tay Limestone.† At the outset he describes the macroscopic and microscopic structure of the hornblende schists and epidiorites, as shown in typical specimens from the great sill or sills that accompany the Loch Tay Limestone across the whole of the Highlands. Next the author described in detail the above-mentioned sill, showing that it invariably accompanied the limestone, always outcropping at the surface where the limestone is to be found. He thus summarised his conclusions:—(1) These hornblende schists and epidiorites were originally intruded into the clastic rocks as sills of igneous rock at a period prior to the general metamorphism of the region; (2) though difficult to say definitely, it is probable that they belonged to some member of the diorite group; (3) subsequent to their

* *Trans.*, vol. vi., p. 157. † *Trans.*, vol. x., p. 302.

intrusion, and during the great period of regional metamorphism which affected the Highlands, these rocks underwent a profound change. The original felspars were crushed and broken into water-clear grains, having all the appearance of a clastic rock, while the ferro-magnesian constituents re-crystallised into hornblende, in many cases a perfect foliated or schistose structure being superinduced upon the rock.

Mr. Macnair contributed to the British Association Handbook for 1901 the chapter dealing with the crystalline schists of the Highlands,* and this year he has published an exhaustive work "On the Scenery and Geology of the Grampians and the Valley of Strathmore." According to his latest work, the author considers that a careful study of the fragments of the ancient mountain chain preserved in the Scottish Highlands points to the conclusion that a great central massive must have risen over what is now the Midland Valley, and that the Ben Lawers anticlinorium is to be regarded as but a subsidiary flexure of the strata when compared with the great central fächer.

Along the shores of the Firth of Clyde we just catch a glimpse of the northern limb of the great central massive. Between Loch Lomond and Loch Lubnaig the schists are traversed by a series of cross faults which emerge from the great boundary fault. They are of pre-Old Red Sandstone age, and strike north-east and south-west.

In the northern limb of the central massive exposed along the western shores of the Firth of Clyde we have the lowest members of the crystalline schists of the Highlands coming out from beneath the younger schist zones of the interior. This is represented by the Lower Argillaceous zone or Dunoon phyllites, and is succeeded towards the interior by the Lower Arenaceous zone, Loch Tay Limestone zone, Garnetiferous Schist zone, Upper

* "Handbook on the Natural History of Glasgow and the West of Scotland," p. 414.

Argillaceous zone, and Upper Arenaceous zone. From an examination of the relationship in the field of these different schist zones, the order given above appears to be an ascending one, proceeding from the margin inwards, the well-marked zone known as the Loch Tay Limestone forming a sort of datum line from which one can recognise the position of the lower and upper schists.

In 1902 Mr. William Gunn, F.G.S., read a paper entitled "On a Volcanic Series associated with the Schists of North Glen Sannox."* These old lavas are here associated, as at Ballantrae, in Ayrshire, with cherts and dark shales, and it is not at all improbable that, like them, they are of Arenig age.

In north Glen Sannox the whole series appears to be regularly and conformably intercalated with a portion of the Highland schists. They occupy a strip of country which crosses the glen in a north and south direction between 1½ and 1¾ miles in length, with a breadth varying from 100 to 400 yards. At its lowest point in the burn it is about 120 feet above sea-level. The rocks have all a high dip to the south-east, and sometimes they are vertical, but there is much folding in places. They apparently overlie a thick series of schistose grits, which are well exposed at the bridge across the north Sannox Burn, and they dip under another set of schistose grits, which, however, can only be studied on the southern side of the glen, as they are cut out on the northern side by the Highland fault, which brings down the Lower Old Red Sandstone against the volcanic series. The general succession of these rocks appears to be as follows in descending order:—

(7) Coarse schistose grits, smooth weathering.

(6) Thin bands of slaty schists apparently alternating in places with thin bands of trap and traces of dark schist.

(5) Upper trap bed, greenish grey in colour, fine-

* *Trans.*, vol. xii., p. 192.

grained, and in places schistose, with lenticular bands of agglomerate.

(4) Bands of light-coloured and dark chert, with much laminated dark schist and a band of schistose grit.

(3) Lower trap bed, often massive, sometimes containing bands of agglomerate, *e.g.*, on the north side of the glen.

(2) Bands of black schist, associated occasionally with chert and some slaty schist.

(1) Thick mass of strong schistose grits, some greenish.

The cherts are granulitised to a great extent, and no traces of radiolaria have been found in them. The black schists were diligently searched in several places, but, unfortunately, no traces of organisms of any kind have yet been found. It is, therefore, unwise perhaps to dwell too much on the undoubted resemblance between this volcanic series and its associated beds with those of the Arenig rocks of Ayrshire at Ballantrae. All that can be said is that the rocks in the two localities are probably contemporaneous.

Strips of rocks of somewhat similar character and probably of the same age have been found by Mr. Gunn's colleagues in the Survey, Messrs. Barrow, Clough, and Dakyns, at various places along the Highland border from Dumbartonshire to Kincardineshire, but nowhere, except in Arran, do these rocks appear to be intercalated in the Highland schists.

In 1902 Mr. P. Macnair read a short paper entitled "Notes on the Green Beds on Sron Aonaich and near Ardlui, Argyllshire."* He pointed out that, stratigraphically, the "Green Beds" were in a position near the top of the Lower Arenaceous zone, and occupy a horizon not far below the Loch Tay Limestone. Towards the Ben Lawers "fächer" or fan structure the "Green

* *Trans.*, vol. xii., p. 231.

Beds" dip in simple outcrops below the Loch Tay Limestone. Between the great axial line of folding and the frontier Highlands they are repeated again and again in isoclinally-folded strata in outliers between the folds of Ben Ledi grits. A detailed stratigraphical and petrological description is then given of the outliers on Sron Aonaich, a shoulder of Ben Lomond, and in the railway cutting on the West Highland line north of Ardlui Station.

A short paper was read by Mr. Macnair in 1905 entitled "Notes on the Discovery of an Outlier of the Loch Tay Limestone on Beinn Bhreac, Loch Tay, Perthshire."* After describing the geological position and geographical extent of the Loch Tay Limestone in the neighbourhood of Loch Tay and west of the great north-east and south-west fault, the author stated that on the east side of the fault the Loch Tay Limestone was supposed to have almost entirely disappeared, the visible schists apparently belonging to a lower horizon, except in a single case, where a well-known outlier of the limestone occurs near the top of Meall-na-Creig, a mountain about two miles south-east of Ardeonaig. The author then described in detail a similar outlier of the limestone which occurs near the summit of Beinn Bhreac, a hill about two miles east of Ardtalanaig.

ORDOVICIAN AND SILURIAN.

Turning now to the Ordovician and Silurian rocks of the Southern Uplands, we find that several important papers on the stratigraphy of this region have been contributed to our *Transactions*. In Sir A. Geikie's paper on "The Order of Succession among the Silurian Rocks of Scotland,"† published in 1867, a summary is given of the views he had adopted as to the structure of the region. Briefly stated, he believed that a great anticlinal fold extended in a north-east and south-west direction, cross-

* *Trans.*, vol. xii., p. 318. † *Trans.*, vol. iii., p. 74.

ing the Annan Valley a little south of Beattock. This central portion was regarded by him as of older date than the rocks near the margins of the area where Upper Silurians are found on the north at Lesmahagow and the Pentlands, and on the south at Kirkcudbright. Pending the detailed mapping of the country, he says the succession seems at present to range from Llandeilo flags, represented by the beds along the axis, to the Lower Llandovery, to which certain Ayrshire beds seem to belong. The hard, grey grits, greywacke, sometimes conglomeratic or brecciated, blue, red, or olive shales, and occasional but inconstant bands of limestone, which make up nearly the whole of the Southern Uplands, are, in default of more detailed palæontological data, more safely referred to the Caradoc and Llandeilo rocks of Wales.

The next contribution to the stratigraphy of this region that appears in our *Transactions* is a paper by Professor Lapworth, published in 1872.* In this paper the author points out that the theory advanced by Professor Harkness, that the bands of black shale which occur in the Southern Uplands are one and the same deposit, had gradually given way to another that had recently been adopted by the officers of the Geological Survey. According to this new theory, there are several distinct bands or groups of bands on very different geological horizons, they being divided from each other by enormous thicknesses of comparatively unfossiliferous strata. In his paper Professor Lapworth differs from the views that had been arrived at by the Survey. He maintains that there is but a single group of these graptolitic shales of from 500 feet to 600 feet in thickness. This group he called the Moffat shale, subdividing it into the Lower, Middle, and Upper Moffat. The vertical thickness of these divisions vary to a considerable extent, and each is characterised by a great abundance of graptolites. Professor Lapworth, in dealing with the palæontological aspect

* "On the Silurian Rocks of the South of Scotland." *Trans.*, vol. iv., p. 164.

of the question, points out that there are nearly a hundred species of graptolites occurring in these rocks, of which about one-third have not been described. He had also arrived at the conclusion that certain of these graptolites were restricted in their vertical distribution; that it is impossible to say at present that there are half a dozen forms which are not peculiar to one or other of these divisions. The major divisions of the series could be subdivided into several distinct *zones* characterised by some well-marked species or by a peculiar group of graptolites. These zones are easily recognisable, and furnish exactly the same fossils in localities widely separated from each other. In this paper Professor Lapworth still adopts the idea of a great axial line of folding running between Berwick and Dumfries, and bringing up the oldest rocks in its centre. He also gives the following comprehensive classification of the rocks of the southern Uplands:—

(*a*) *Lower Silurian*—	
(1) Hawick and Selkirk Rocks,	Cambrian, Skiddaw, &c.
(2) Moffat Shale or Anthracite—	
(*a*) Lower Anthracite, -	Lower Llandeilo.
(*b*) Middle Anthracite, -	Upper Llandeilo.
(*c*) Upper Anthracite, -	Lower Caradoc.
(*b*) *Middle Series*—	
(1) The Gala Group, Girvan Series, Duntercleuch Beds, Wrae Beds, &c., - -	Upper Caradoc. Lower Llandovery. Upper Llandovery.
(*c*) *Upper Silurian*—	
(1) The Balmae and Riccarton Beds, - - - -	Wenlock and Lower Ludlow.
(2) Lower Pentland Beds, -	Wenlock.
(*b*) Upper Pentland Beds,	Ludlow.
(*c*) Pentland Sandstone, - (3) Lesmahagow Beds, - -	Passage Beds and Downtonian Sandstone.

In the year 1876 Professor Lapworth contributed the chapter on "The Silurian System of the South of Scotland" to the "Catalogue of Western Scottish

Fossils."* In this paper he gives a table which shows the succession of the strata with their English equivalents. In this classification the Birkhill shales, Gala group, and Hawick rocks are regarded as one formation, to which he gives the name "Valentian," after the ancient Roman name of South Scotland, the English equivalents of these subdivisions being the Llandovery, Mayhill, and Tarannon beds respectively.

In that section of his paper which deals with the Leadhills district in the Upper Ward of Lanarkshire, Professor Lapworth shows that, as in the Moffat area, the country is floored mainly by Valentian strata, here, however, often much altered and mineralised. There are the usual long lines and patches of the underlying black shales in abundance, the latter, however, being rarely in a state admitting the preservation of their included fossils.

Professor Lapworth also says, "There are no Birkhill shales in this district (unless, indeed, they are represented by the lowest Valentian zones), the highest black shales visible being the top zones of the Middle Moffat or Hartfell shales. The Lower Moffat shales occur in most localities, and the peculiarly indurated bands of siliceous flag are often remarkably conspicuous. Every fossil of the Lower Moffat shales has already been collected from this area, and there seems to be a perfect similarity in their vertical range in the Leadhills and Moffat districts.

The Valentian rocks of the Leadhills district have the same lithological characters as those of the Moffat area. Sometimes they contain fossiliferous zones, as at Dundercleuch, Snar, Wallace's Cast, &c. These beds when traced along the strike rapidly lose their fossiliferous character, and degenerate into the normal barren greywacke. On the same horizon, however, similar fossiliferous bands occur to the north-east in Peeblesshire, at Wrae Hill, Stobo, Killneho, and Winkstone, and to the south-west near Moniaive and Dalry. The fossils show that the beds are in all probability of Llandovery

* "Catalogue of Western Scottish Fossils," p. 1.

age, and the continuation of the fossiliferous deposits of the Girvan area.

Referring to the Silurian rocks of the Girvan district, the author states—"There can be little hesitation in regarding all except the lowest beds as constituting a portion of the great Valentian formation, into which, indeed, they dip everywhere on the south of the valley of the Stinchar. The facts gathered in the district itself point out a succession, of which the following is a summary:—(*a*) The crystalline and metamorphic rocks of Ballantrae; and (*b*) the fossiliferous limestones, the majority of the fossils being considered as of Bala age. These are followed by the representatives of the Lower Girvan series and Upper Girvan series." Lists of the fossils are given, and many of the graptolites characteristic of the different groups are given. A notice of these will be found in the chapter dealing with the fifty years of palæontological research.

The publication of Professor Lapworth's memoir in 1878 on "The Moffat Series" in the *Quarterly Journal of the Geological Society* marks an epoch in the study of the Silurian rocks of the South of Scotland. It has been well said of this paper—"It remains the greatest and most original contribution to the study of the life-sequence and structural relations of these highly convoluted rocks."

About six months after the contribution of his paper to the London Society, Professor Lapworth gave a summary of his views to our own Society in a paper entitled "Recent Discoveries among the Silurian Rocks of the South of Scotland."* It seemed very fitting that his friend and co-worker in the same field, Mr. James Dairon, Vice-President of the Society, should have occupied the chair on this occasion. After passing in review the various opinions that had been held as to the structure of this area, the author gave the following summary of his conclusions regarding the sequence and structure of

* *Trans.*, vol. vi., p. 78.

the rocks. No apology is needed for quoting Professor Lapworth's summary in his own words:—

"The discoveries made of late years by the author enable him to suggest a new theory of the succession, which is in harmony both with the stratigraphical and palæontographical evidences, and brings the South Scottish Silurians into perfect harmony with those of other countries. The district which has yielded the most conclusive proofs of the true sequence lies in the neighbourhood of Moffat. At the head of Moffatdale a deep gorge, known as Dobb's Linn, affords a magnificent section of the black graptolite shales. The author showed that the black shales of this spot are arranged in an anticlinal form, and come out conformably from below the greywacke of the district. These black shales fall into three natural divisions denominated the Glenkiln, Hartfell, and Birkhill shales. Each of these three divisions contains a special graptolite fauna of its own, and breaks up again into many subordinate zones, individualised by special mineralogical and palæontological distinctions. It was explained that this section gives us the key to the district. All the black shales of the neighbourhood were found to rise in arches from below the greywackes, and to show the same divisions, zones, and fossils as at Dobb's Linn. This series of graptolite shales (which is termed the Moffat series) is unique among Scottish formations in the rapid change which takes place among its fossils, for the whole formation is only about 300 feet in thickness in the typical localities, and each fossil ranges through a fraction only of that extent. The author showed that the fossils of the Glenkiln division were those of the very highest beds of the Llandeilo of Wales, Sweden, and America. Those of the Hartfell division are those of the Bala beds of Conway, Scandinavia, and New York. Those of the Birkhill shales are all found in the Lower Llandovery of Westmoreland, Thuringia, Sweden, Brittany, &c. It was contended that these results proved that the three divisions represented the

highest Llandeilo, the Bala, and the Lower Llandovery of Wales, and that the similarity of the succession of forms in the countries cited demonstrated the correctness of the author's reading of the structure of the Moffat area.

"The excessive thinness of the three formations in the area was shown to agree precisely with the facts known in Britain and Scandinavia, and it was argued that the Moffat series were simply British Silurian of the Scandinavian type.

"These black shales are by no means confined to the Moffat district, but rise again and again to the surface to the north and west. It was shown, by a comparison of their fossils with those yielded by the Moffat series, that all these black shales are clearly repetitions of those of the Moffat districts; and proofs were adduced to show that they invariably rose out from below the barren greywackes in anticlinal forms. It follows, therefore, that the whole of these greywackes form a single sheet from St. Abb's Head to the Mull of Galloway; of later age than the Moffat series, and thus, generally speaking, of Upper Llandovery age. It was pointed out how perfectly this conclusion harmonises with what is known of the few fossils they yield, and how it not only rids us of the necessity of the supposed great anticlinal line between Berwick and Dumfries, but also does away with the hypothetical unconformabilities at the base of the Caradoc, and at the commencement of the Upper Silurian. The dark graptolitic shales, which, when followed to the north-east and south-west from the Moffat district, retain all their zones and fossils absolutely without alteration, rapidly lose their black seams one by one as they are followed over the ground to the north-west, and are gradually replaced in that direction by grey shales and conglomerates of a far greater collective thickness. It is those beds which afford the Caradoc and Llandeilo fossils of Peebles, Lanark, and Girvan. The deepest, or Glenkiln division, which even in the Moffat area contains a large admixture of felspathic matter, puts on a more

decidedly volcanic aspect as it is traced to the north-west.

"These facts form the foundation for the author's theory that the Lower Silurian rocks of the Southern Uplands are simply composed of two distinct formations—the shaly Moffat series and the overlying and arenaceous formation termed the Gala group. The former represents the Upper Llandeilo, Caradoc, and Lower Llandovery of Wales. The latter comes into the place of the Upper Llandovery. The sequence in the typical districts from the Llandeilo to the Ludlow is unbroken by any visible unconformability.

"In conclusion, the author gave a short summary of the results of his more recent researches in the difficult area of Girvan, showing how naturally the facts obtainable in that area agree with his theory of the succession. These investigations have had the result of distinctly establishing the true sequence in that district, as originally sketched out by him in 1876 in the 'Catalogue of the Western Scottish Fossils.'

"The Upper Girvan rocks prove to be the lower beds of the Gala group of the Moffat district. The Lower Girvan conglomerates, flagstones, &c., are the greatly thickened equivalents of Hartfell and Birkhill shales of Moffat, and yield many of the same fossils in the same relative order. Below the Lower Girvan beds, however, there is a partial break, the basal conglomerate of Kennedy's Pass lying upon the great volcanic and partially metamorphic series of Ballantrae, and to a great extent being composed of its weathered fragments. This volcanic series (together with the limestones which accompany it) stands generally in the place of the Glenkiln shales of Moffat. It thus occupies the precise stratigraphical place of the great volcanic series of the Lake District, and is the most ancient formation yet detected in the South of Scotland. Mr. Lapworth's paper was illustrated by a number of coloured maps and diagrams illustrative of the districts under discussion."

Stratigraphical Geology.

In vol. vii. of the *Transactions* (1881-84) there appears a number of papers dealing with the Silurian rocks of the Southern Uplands and the Upper Silurian inliers which appear to the north of the great tableland of that region. In 1881 Dr. J. R. S. Hunter read a paper entitled "The Silurian Rocks of the Logan Water, Lesmahagow."* In this paper it is shown that the Upper Silurian rocks of the Lesmahagow district form a great anticlinal arch with Nutberry Hill as its centre. A somewhat detailed description is given of the different sections exposed in the Logan Water and its tributaries, and an account is given of the various fossiliferous horizons and their organic contents. In another paper Dr. Hunter gives an account of three months' camping in the upper reaches of the Logan Water; his tent was pitched at a place known as Shanks' Castle, with the object of collecting the Upper Silurian fossils, which occur in great numbers in the shales and mudstones exposed in the numerous sections laid bare by the action of the stream and its tributaries. It was during these excavations that Dr. Hunter found the first traces of the fish fauna of this region and also the fossil scorpion *Palæophonus caledonica*, which was long regarded as the earliest air-breathing animal which had as yet been found in the strata of Great Britain.

In the same year (1881) Dr. Forsyth read a paper entitled "Notes on the Silurian Rocks of the Muirkirk District,"† in which he describes the south-western extension of the Upper Silurian inlier of Lesmahagow, and, in addition, the smaller inlier seen in the Hagshaw Hills. In 1884 the same author contributed a valuable paper on "The Silurian Rocks of the Girvan District."

In 1884 Mr. Arthur Macconochie read a paper to the Society, of which an abstract is given in the *Transactions*.‡ He pointed out that two readings of the order and succession among the complicated rocks of the Southern Uplands claimed the attention of geologists, namely, that

* *Trans.*, vol. vii., p. 56.

† *Trans.*, vol. vii., p. 74.

‡ "Review of the Southern Silurian Question." *Trans.*, vol. vii., p. 370.

adopted by the officers of the Geological Survey, and that of Professor Lapworth. In conclusion, it appeared to the author that, while admitting there may be some anomalies in the Survey reading, these seemed to him insignificant when compared with the difficulties and contradictions to which the adoption of Professor Lapworth's views would commit us.

In 1892 Dr. Forsyth contributed a paper on "The Geology of the Carsphairn District of Kirkcudbright.* After defining the area under notice, he proceeds to give a detailed account of his stratigraphical and palæontological investigation. The following is the summary of his conclusions, which he gives at the end of his paper:—

(1) From the constant occurrence of the typical Glenkiln and Hartfell graptolites in the same shales, and the absence of graptolites in other beds, it seems as if these two zones in the Carsphairn area come together without any intervening flags or sandstones.

(2) From the persistence of certain forms (*Didymograptus superstes*, *Dicellograptus sextans*, and *Dicranograptus tardiusculus*), one side of the shale bed seems to be Glenkiln, and the other side, from the prevalence of equally typical forms (*Diplograptus quadrimucronatus*, *Leptograptus simplex*, and *Pleurograptus linearis*), seems to be Hartfell.

(3) Under these circumstances, the Carsphairn grits would occupy the central dome of an anticline and form the lowest rocks of the district, corresponding, possibly, with the Barr conglomerates, and flanked by the newer Glenkiln and Hartfell shales, and these in turn by the thick-bedded Dalveen flags.

(4) The muddy shales of Carlin's Cairn and Knockgray are interpolated between the black shales and the flags, and correspond to the Ardwell beds.

(5) And the banded cherty flags which so regularly accompany the black shales may be the representatives of the Stinchar Limestone. Perhaps another search along

* *Trans.*, vol. ix., p. 376.

the shoulders of Dunool and Cairnsmore may give the same relations as occur at Carlin's Cairn.

In the handbook issued for the meeting of the British Association in Glasgow in 1901 lists of the fossils of the Ordovician and Silurian Rocks of the Clyde Valley are given by Dr. Horne, Dr. B. N. Peach, and Mr. J. Macconochie. These are accompanied by a short introduction dealing with stratigraphy of the rocks and a table showing the classification of the Silurian rocks throughout the Silurian Uplands. Short descriptions of the Leadhills and Girvan districts are also given, the latter being accompanied by a table of the strata, showing the characteristic fossils of each horizon.

Old Red Sandstone.

There are only a very few papers in our *Transactions* bearing upon the Old Red Sandstone rocks of Scotland. The first of these was contributed to the Society in 1876 by Sir Arch. Geikie.* In this paper he proceeds to consider the development of the Old Red Sandstone in the British Isles under its accepted threefold division into Lower, Middle, and Upper. The lower member, whenever its true base can be seen, passes down conformably into the Upper Silurian rocks. The passage beds are well shown in the Upper Ward of Lanarkshire in the neighbourhood of Lesmahagow. He also points out that along the flank of the Grampians a great fault runs from the North Sea at Stonehaven to the estuary of the Clyde, which has had the effect of throwing the strata of the Old Red Sandstone on end, sometimes for a distance of two miles from the line of the dislocation. One of the most striking features in the formation is the enormous development of its contemporaneous volcanic rocks, as shown in the Ochil and Sidlaw Hills. The author then proceeds to discuss the Middle Old Red Sandstone of Caithness, and arrives at the conclusion that it is not really later in time than the Old Red Sandstone of the

* *Trans.*, vol. v., p. 275.

Midland Valley. They are contemporaneous, and of Lower Old Red Sandstone age. Proceeding to deal with the Upper Old Red Sandstone, the author points out that, whenever the top of the series can be seen, it is found to pass gradually and conformably into the base of the Carboniferous system. If we work our way into the red rocks from the Carboniferous side, we may claim them as merely the base of the Carboniferous system. If we approach them from the side of the Old Red Sandstones we may well regard them as a late and unconformable subdivision of this system.

Dr. John Horne, of the Geological Survey, contributed a paper in 1881 to the Society upon "The Volcanic History of the Old Red Sandstone North of the Grampians."* At the outset he directs attention to the remarkable development of volcanic activity in Lower Old Red Sandstone times in the great Midland Valley of Scotland. Proceeding to deal with the Old Red Sandstone of the Moray Firth and Caithness, he points out that the records of volcanic action in that district are comparatively meagre, and that it is only when the Shetland Islands are reached that abundant proof of prolonged volcanic activity is found in the large masses of intrusive granites and felsites, as well as in the sheets of lavas and tuffs. The lithological character of these rocks is also described, and reference is made to their microscopic structure. Dr. Horne adopts the twofold division of the Scottish Old Red Sandstone advanced by Geikie, and classes the Caithness rocks as Lower Old Red.

In 1885 Dr. Hunter read a paper on "The Old Red Sandstone of Lanarkshire, with Notes on Volcanic Action during Old Red and Carboniferous Times."† He describes in this paper the Lower Old Red Sandstone as it is developed in the Hagshaw, Whitehaugh, Avon, Glengavil, Kype Water, Lesmahagow, and Lanark districts.

In 1896 Messrs. James Reid and Peter Macnair con-

* *Trans.*, vol. vii., p. 77. † *Trans.*, vol. viii., p. 161.

tributed a paper on "The Genera *Lycopodites* and *Psilophyton* of the Old Red Sandstone Formation of Scotland,"* and in the following year, along with Mr. W. Graham, they wrote a paper on "*Parka decipiens:* Its Origin, Affinities, and Distribution."† The stratigraphical value of these fossil plants is pointed out; this will be dealt with in more detail in the following chapter.

In 1901 Mr. J. G. Goodchild wrote the section on the Old Red Sandstone of the Clyde area for the British Association Handbook.‡ In this paper the author refers the Downtonian rocks of the Upper Silurian inlier of Lesmahagow to the Lower Old Red Sandstone under the term Lanarkian Old Red. He points out that the study of these rocks shows that they have shared in all the disturbances to which the Silurian rocks have been subjected. He also maintains that these disturbances had ceased, and a vast amount of denudation taken place, before the Caledonian Old Red was laid down unconformably upon the Lanarkian. The Caledonian Old Red contains abundant evidence of volcanic action, and on the south-eastern slope of Tinto the andesitic lavas are seen to overstep the various members of the Lanarkian rocks in a manner which impresses one very much with the importance of the chronological break between the two formations. The Lanarkian Old Red has yielded a rich fish fauna from the rocks of the Birkenhead Burn, and, in the Caledonian Old Red, specimens of *Cephalaspis Lyelli* have been found at Lanfine and Lesmahagow. Mr. Goodchild also discusses in this paper the physical conditions under which these rocks were accumulated. The Upper Old Red Sandstone everywhere lies with a strongly marked unconformity upon the rocks below, including the granites, which are contemporaneous with the Caledonian Old Red volcanic rocks. The Upper Old Red Sandstone includes no volcanic rocks. It has yielded

* *Trans.*, vol. x., p. 323.

† *Trans.*, vol. xi., p. 105.

‡ "Handbook on the Natural History of Glasgow and the West of Scotland," p. 462.

fossils at a few localities within the basin of the Clyde, chiefly at the Heads of Ayr.

CARBONIFEROUS.

Passing to a consideration of the work that has been done in connection with the stratigraphy of the Carboniferous rocks of the West of Scotland, it has been pointed out that Craig had mapped out the great subdivisions of the Carboniferous rocks of Lanarkshire as early as 1839. These subdivisions, as determined by Mr. Craig, have already been given in Chapter I.

In Dr. Young's paper on the Campsie district a detailed description is given of the Carboniferous rocks of that district. This paper, as has already been stated, forms the first part of vol. i. of our *Transactions*. It was published in 1860; subsequent editions also appeared in 1868 and 1894. From the Old Red Sandstone lying below he carefully noted the sequence of the several members of (1) the "Calciferous Sandstone series," including the Ballagan Limestone series and the interbedded lavas, and (2) the several members of the Lower Limestone series. The successive members of this "Lower Limestone" group, in ascending order, and divisible by their constitution and their fossils, he defined as that of Mill Burn, of Balgrochan Burn, of Balglass Burn, of Craigenglen, of the Main Limestone and Coal, of the Hosie Limestone and of Corrie Burn. The Balquharrage series belonging to the Upper Limestones also occurs. He also pointed out that in the above-mentioned groups of strata there are several seams of coal of not very good quality. There are some good cement stones, and a large proportion of the Campsie shales contain useful ironstone. Others of them are good oil shales in which the crowded organisms, such as Entomostraca, have supplied, as he shows, the hydrocarbon. Marine shells are abundant in many of the strata, but in some limestones and shales they are wanting, only remains of plants, fishes, and entomostraca

remaining in evidence of what is regarded as estuarine conditions of these particular deposits.

In 1867 Professor John Young and Dr. Young read a joint paper on "Local Unconformity as illustrated in the Carboniferous Rocks near Bishopbriggs."* In Coltpark Quarry Dr. Young had discovered a series of vertical beds beneath the nearly horizontal main post of the Bishopbriggs Sandstone, and in this paper the authors described and illustrated by diagrams the detailed survey they had made of the neighbourhood. They considered that the vertical beds are a part of those lying beneath the Cowglen Limestone, that about twenty-five feet of strata have been removed by denudation, and that the extreme local nature of the disturbance is such as might be due to an intrusion of greenstone, of which two examples are seen not far off. They concluded with some general remarks upon local unconformity without disturbance, as abundantly illustrated in the same district, and on the uses of the terms unconformity and overlap.

In 1868 Dr. Wm. Grossart read a paper on "The Upper Coal Measures of Lanarkshire."† He defined the stratigraphical boundaries of the Upper Coal Measures—the upper and natural one being the junction of the New Red Sandstone with the Carboniferous strata at about 80 fathoms above the "Ell Coal," and the lower the "slaty band" ironstone. He adopted this as a base-line, because it was the horizon beyond which in an ascending scale no brachiopoda were found. He described the position, mineral character, and economic value of all the workable coal and ironstones, from the "Palacecraig" Ironstone to the slaty band. A difficulty was frequently experienced in recognising certain coal beds, such, for instance, as the "Drumgray." It was a good test that, if in the first coal under the "Virtuewell" seam *Anthracosia rugosa* was found, it may be safely assumed that it was Drumgray. Dr. Grossart also gave a detailed account of the palæontology of this group of rocks.

* *Trans.*, vol. ii., p. 283. † *Trans.*, vol. iii., p. 96.

Mr. John Young read a paper in 1868 on "The Section of Strata at present being worked in the Western Portion of the Gilmorehill Grounds for the purpose of obtaining Building Stone for the Erection of the New University."* The chief interest to the geologist in this quarry consists in the numerous strata therein exposed, there being no fewer than twenty-six different beds in the depths of 60 feet from the surface. These consist of five seams of free coal, varying in thickness from 9 to 18 inches; five beds of sandstone, with accompanying strata of clay shale, bituminous shale, fireclay, and a thin seam of blackband ironstone. The geological position of the strata is in what is known in the Glasgow district as the Possil Lower Coal and Ironstone series, which lies about 510 fathoms under the Upper Red Sandstone of the Lanarkshire coalfield. Mr. Young next pointed out the relation which the Possil series bears to the strata of other portions of the Scottish coalfield, and stated that they occupy a middle position in the Carboniferous Limestone series of this country; yet in this district, throughout a thickness of 900 feet, no limestone band or other calcareous strata are found. Their lithological character, and the nature of the organic remains, present us with conditions very similar to that which prevailed during the deposition of sedimentary strata of the Upper Coal Measures of Western Scotland.

An important paper on "The Stratigraphy of the Upper Limestone Series" appeared in the *Transactions* for the year 1869.† This paper was written by Mr. Hugh M'Phail of Nitshill, and was entitled "The Carboniferous Stations of the Levern Valley, Renfrewshire." The paper was illustrated by a cross-section from Waulkmill Glen to Crookston Hill, representing the succession of the beds from the Hurlet and Nitshill Main Coal series upwards. The valley of the Levern is divided into two portions, the southern being drained by the Aurs, joined by the Brock, and the northern by the Levern, the natural trough of the

* *Trans.*, vol. iii., p. 298. † *Trans.*, vol. iii., p. 254.

valley being in the southern division. Commencing at a brown sandstone a few feet from the surface in the centre of the trough, Mr. M'Phail described the lithological character of the different strata down to the base of the section, embracing upwards of 300 fathoms. Four great faults traverse the valley in a direction nearly east and west, which are crossed by smaller faults at various angles. These have produced upthrows of the strata to the westward.

Mr. Robert Craig read, in the year 1869, a paper dealing with "The Geology of the Carboniferous Basin of Dalry, Ayrshire."* The area described is the triangular basin situated in the parishes of Dalry, Kilbirnie, and Beith, the south-west angle of which extends into the north of Kilwinning, and has narrow extensions, one north-east into the Castle Semple Valley, the other into the Lugton Valley to Shellord. After defining the boundaries of the basin and giving a sketch of the trap hills which surround it, Mr. Craig minutely described the limestone series as developed in the neighbourhood of Beith, consisting of limestone, shale, sandstone, thin seams of coal, &c., which also crop out in the beds of the various streams which descend from the hills on the opposite side of the valley with similar lithological characters. The author next described the various sections exposed at Rye Water, Auchenskeigh, Auchenmade, and other localities around the basin. The underlying beds of the district are rich in fossils, chiefly *Brachiopoda*, some beds 3 feet in thickness being entirely composed of *Producti*. A band of limestone 2 feet thick at Broadstone is made up of a coral (Lithodendron), while other beds have yielded numerous specimens of the teeth and spines of fishes.

In their joint paper on "The Carboniferous Fossils of the West of Scotland,"† published in 1871, Messrs. Young and Armstrong give a generalised vertical section of the Carboniferous rocks in the West of Scotland and

* *Trans.*, vol. iii., p. 271.

† *Trans.*, vol. iii., Supplement.

neighbourhood of Glasgow. The valuable index to localities given at the end of their paper also contains numerous notes relating to the natural and artificial sections from which the fossils have been collected.

In 1871 John Young read a paper on "Notes on a Section of Strata containing Beds of Impure Coal and Plant-Remains showing Structure at Glenarbuck, near Bowling."* The author shows that these coal beds and shales, with plant and fish remains, reveal the interesting fact that during the time traps and trappean ashes were being ejected by the volcanoes of the Lower Carboniferous period, long intervals occurred in which forests of *Sigillariæ* and other plants flourished over these tracts, and accumulated vegetable matter sufficient to form thin seams of coal. These were subsequently overlaid in some cases by lake deposits, in which the remains of fishes were embedded, and these in their turn by other outbursts of igneous rock matter and ashes.

Mr. James Neilson, in 1872, read a paper entitled "On some Sections of Carboniferous Limestone near Busby."† In this paper he gives the results of a detailed examination of the quarries in that neighbourhood. In the paper four quarries are referred to; these lie to the north-east of the Eaglesham Road Station on the Busby and East Kilbride Railway. The best section is that seen in Thornton Quarry, which shows three bands of ironstone, three beds of limestone, seven or eight beds of shale, and a bed of impure limestone and volcanic ash, containing rootlets of *Stigmaria*. The highest shale in the section contains an abundance of well-preserved fossils, many of them converted into iron pyrites. A bituminous shale underlying the volcanic ash contains many fragmentary fish remains, scattered scales, and bones, and is known locally as the "fish bed." Mr. Neilson gives at the end of his paper a list of the fossils obtained from the various quarries.

In their two papers, published in 1873 and 1875, upon

* *Trans.*, vol. iv., p. 123. † *Trans.*, vol. iv., p. 282.

the fossils of the Robroyston and Orchard Limestones respectively,* Messrs. Young and Armstrong give brief introductory notices of the stratigraphy of the Upper Limestone series in the neighbourhood of Glasgow. In the first paper they deal with the Robroyston Limestone and its fossils. This paper was published about the same time as the issue of the Geological Survey map for the district, and the Robroyston Limestone is taken as the line of demarcation between the Millstone Grit and the Carboniferous Limestone series to the north of Glasgow, while the Arden Limestone found at Thornliebank, Pollokshaws, and Barrhead is taken as the equivalent to the Robroyston on the south. The following quotation from their second paper gives the succession of the Upper Limestone series as they were then believed to occur in the neighbourhood of Glasgow:—"Taking the index or Cowglen Limestone of Pollokshaws district as the lowest limestone of the Upper Limestone series of the Clyde Coal Basin, we have in ascending series over it first the thick bedded sandstones of the Giffnock and Bishopbriggs Quarries; second, a little higher in the series, the Orchard Limestone and shales; and third, the Arden and Robroyston Limestone on a still higher horizon, the latter being made the boundary stratum between the higher beds of the Carboniferous Limestone and the Millstone Grit group. This upper group of limestones, with their accompanying strata, forms a well-marked division between the overlying Millstone Grit on the one hand and the underlying coals and ironstones on the other, these latter in their turn resting on the lower group of Carboniferous Limestone strata."

In 1874 John Young read a paper on "A Bed of Fine-grained Indurated Sandstone, enclosing Rolled Pebbles of Quartzite interstratified with the Trap of the Campsie Fells."† The striking feature of this conglomerate is the entire absence in it of fragments of the underlying

* *Trans.*, vol. iv., p. 267, and vol. v., p. 250.

† *Trans.*, vol. v., p. 51.

trap. Mr. Young examined it over a wide area, without finding in it any portions of these evidently previously existing volcanic rocks. The only explanation seems to be that at the time these sandstones and conglomerates—the detritus of ancient high lands to the north and west—were laid down over them, these bedded traps existed as a submarine bank, so deep under water that they were not exposed to disintegration.

In 1875 Mr. James Neilson contributed a paper entitled "Notes on the Cuttings in the City of Glasgow Union Railway between Bellgrove and Springburn."* In this valuable paper a detailed account of the strata seen in the different sections exposed in the railway is given. The paper is also accompanied by an exhaustive list of the fossils found in the different beds that were passed through.

In 1878 Dr. John R. S. Hunter read a paper on "Craignethan and its Vicinity."† This paper gives a detailed section of the Carboniferous strata seen in the Fence Pit, the principal beds seen in it being the Lesmahagow Gas Coal and Ironstone, Maggy Ironstones, Howgate Limestone, Belstaneburn Limestone and shales, Gare Limestone and shales, and other higher series.

In 1879 Mr. John Smith read a paper at an excursion of the Society to Dalry‡ on the 7th June. This was afterwards published in the *Transactions*, and entitled "The Geology of Dalry." In it the author gave an account of the stratigraphy of the Lower Limestone series seen in the neighbourhood of Dalry. The lower portion of these limestones is well seen at Auchenskeith and Auchenmade, and the upper portion at Auchenskeith, Auchenmade, Lower Baidland, Thirdpart, and near Birkhead, on the Caaf Water. Notes on the palæontology of the different strata are also given.

One of the most important contributions to the stratigraphy of the Upper Limestone series in the neighbour-

* *Trans.*, vol. v., p. 222. † *Trans.*, vol. vi., p. 84.
‡ *Trans.*, vol. vi., p. 151.

hood of Glasgow was that made by Captain James Stewart of Williamwood in the year 1881. His paper was entitled "Notes on the Limestones in the Parishes of Cathcart and Eastwood, Renfrewshire."* This paper is intended to correct the 6-inch Geological Survey map, and was founded on a large number of bores that had been put down since the Survey was made. It marks a great advance upon the original mapping of the Survey, as he determined the existence of the Holeburn Limestone as an independent bed lying below the Giffnock Sandstones. In the earlier Survey this band had either been confounded with the Cowglen Limestone below, or with the Orchard Limestone above. The structure of the ground lying between Giffnock and the volcanic beds to the south is clearly brought out, as the different limestones are traced round the basin, and are shown to outcrop in their proper relative position. His paper was accompanied by a geological map, and by a plate of vertical sections, which added a great deal to the previous knowledge of the district.

In 1882 Mr. Robert Craig read a paper on "The Fossiliferous Strata lying between the Lower and Upper Limestones in the Beith and Dalry District."† In this paper he divides the whole of the strata described into three groups of beds—First, from the Trearne and Howrat Limestone to the main clay ironstone; second, from the ironstone to the main coal; and third, from the main coal to the Highfield Limestone, which he makes the base of the Upper Limestone series. These groups are then described in detail, and an account is given of their characteristic organisms. The paper is accompanied by a list of the fossils found in the strata intervening between the Lower and Upper Limestone, it is drawn up in tabular form, and shows the vertical distribution of the fossils through the main divisions and subdivisions of the strata.

In 1884 Mr. Andrew Patton read a paper on "Geological Observations in the Parish of East Kilbride,

* *Trans.*, vol. vii., p. 158. † *Trans.*, vol. vii., p. 86.

Lanarkshire."* This is the most important paper that has been contributed to our *Transactions* upon the stratigraphy of the district. The paper is accompanied by a vertical section showing the strata found in the western portion of East Kilbride. Journals of numerous bores are also given, and at the end is a table, drawn up by Mr. James Coutts, which shows the vertical distribution of the fossils found in the various beds.

In 1885 Mr. Robert Craig read a paper on "The Upper Limestones of North Ayrshire, as found in the district around Dalry and elsewhere."† In this paper he pointed out that the Upper Limestones of North Ayrshire are divided into four distinct series of beds by the intervention of shales and flaggy sandstones, giving to each an independent character, both physically and in extent of area. They are all rich in fossil remains, but with the exception of the lower bed they are of small commercial value, and the collector has not, therefore, the opportunity of searching quarries, as in cases where the limestones are more extensively worked. The following limestones in ascending order are then described:—(1) Highfield Limestone, (2) Hundred Fathom Limestone, (3) Lower Linn Limestone, (4) Upper Linn Limestone. A table showing the vertical distribution of the fossils in the Upper Limestones of North Ayrshire is given at the end of the paper.

In 1887 Mr. James S. M'Lennan contributed a paper entitled "Notes on the Jordanhill Coalfield,"‡ in which he gives an account of the different strata of coal and ironstone found in that district.

In a paper by Mr. Robert Craig, read to the Society in 1888, on "Notes upon a Cutting in the new Kilbirnie Branch of the Lanarkshire and Ayrshire Railway,"§ on the farm of Gurdy, Beith, Mr. Smith compared the succession of beds found in this horizon with those of Kersland Glen in the same neighbourhood, of which he

* *Trans.*, vol. vii., p. 309.

† *Trans.*, vol. viii., p. 28.

‡ *Trans.*, vol. viii., p. 271.

§ *Trans.*, vol. ix., p. 64.

had, in a previous paper, given a full account, and showed that, though varying in thickness from the latter, they were, as proved by their contained fossils, practically identical with them. Mr. Craig called attention to the remarkable fact that from this locality about 60 feet in thickness of the limestones and shales which are present over the greater part of the Beith and Dalry districts are entirely absent, whatever may be the explanation.

In 1889 Mr. J. B. Murdoch contributed a short paper upon "The Journal of a Bore put down for Water at Thornliebank, Renfrewshire."* In it he gives his correlation of the different strata met with in the bore.

In 1891 Mr. James Bennie read a paper on "Scenes and Sections in Thornton Quarries."† After reading the report of one of the Society's meetings the previous year, which spoke of the finding of a reptilian bone in Braehead Quarry, the author was led to examine and arrange his notes upon the limestone quarries of East Kilbride. Taking Thornton Quarry as a typical example, in his own graphic and amusing way he described his various visits and explorations, but his more special purpose was to point out to the younger generation of collectors the opportunities still offered by this field for further examination and discovery. He enumerated the succession of strata met with at Thornton, dwelling more particularly upon those which he thought should be specially and carefully worked out as likely to yield rare or possibly undiscovered fossils.

In 1893 Mr. John Smith contributed a paper on "A Section of Carboniferous Strata near Giffen Station, Kilbirnie Branch Railway."‡ One peculiarity of the section consisted in a portion of the sandstone strata being bent in a most remarkable manner, the only apparent reason being its proximity to a fault. The total length of the section is about 320 feet, and the component strata are seen in this short distance to occupy

* *Trans.*, vol. ix., p. 207. † *Trans.*, vol. ix., p. 276.
‡ *Trans.*, vol. x., p. 25.

a syncline, an anticline, and half of another anticline. There are two faults visible, and a probable third is overlaid by the foundations of the railway bridge. One of the beds exposed in the section is a layer of coal 16 inches thick and above is 3 feet 4 inches of shale.

In 1893 Mr. James Neilson read a paper on "The Calderwood Limestone and Cement-stone, with their associated Shales."* In this paper the author dwells principally upon the physical conditions under which the limestones, cement-stones, and shales have been accumulated. He points out that the organisms obtained from these beds testify to the extraordinary alternations of conditions under which they have been laid down, some having been inhabitants of salt, and some of fresh, or at least of estuarine water.

In 1893 Mr. John Smith read two short papers—one on "A Bed of Fossil Plants, and one of Limestone with Magnesia, in the Calciferous Sandstone Series at Meikle Busbie, near Ardrossan"; the other paper dwelt with "A Bed of Ironstone occurring in Trap Tuff, in the Parishes of Stevenston, Dalry, and Kilwinning."†

In 1895 Mr. James Neilson contributed a paper on "The Old Red Sandstone and Carboniferous Rocks of the North End of Arran, with special reference to a statement in the last edition of Geikie's 'Text-book of Geology, 1893,'"‡ to the effect that the thick limestone of Arran (which is crowded with Carboniferous Limestone fossils) is a part of the Old Red Sandstone formation. At the outset of his paper the author strongly upheld the now generally established belief that the evidence afforded by fossil remains in the rocks is the only trustworthy one we have as to the age of the various formations, of which there has been a definite and ascertained succession, and maintained that if these beliefs were departed from the whole science of geology as now

* *Trans.*, vol. x., p. 61. † *Trans.*, vol. x., pp. 129 and 133.
‡ *Trans.*, vol. x., p. 280.

accepted would be thrown into utter confusion. The author then gives a graphic description of the general rock features of the north end of the Island of Arran, detailing minutely the succession of the stratified beds which surround the granite nucleus, and followed with proof to show that it was an entire mistake to attribute, as had been done in the work referred to, the thick limestone and its adjacent beds, to the Old Red Sandstone, their fossil evidence being overwhelming in support of their true Carboniferous relationship.

In 1895 Mr. J. Smith read a paper on "A Section of Carboniferous Strata in a Cutting of the Caledonian Railway at Lissens, three miles north-east of Kilwinning, Ayrshire."* The strata in this section occupy an intermediate position between the Lower Limestones and the Highfield Limestones, and consequently correspond to those of the coal measures of the Dalry district. There are two occurrences of volcanic ash in the section, apparently the same as, and possibly the tail-end of, one of the beds of the Dalry district, three miles distant, where ash beds occur of considerable thickness.

In 1896 Mr. James Thomson contributed a paper on "The Stratified Rocks of the Shore-line from Clachland Point to the Cock of Arran."† The greater part of this paper was first read to the Society on the 16th January, 1875, but its publication had been held over. It is accompanied by a section that was originally prepared for the meeting of the British Association held at Glasgow in 1876, and was then circulated among its members who took part in the Arran excursion. In this paper the author records the discovery of Carboniferous fossils in the New Red conglomerates at the north end of Arran. He showed that these fossils were found in the derivative limestone boulders which are found in the basal conglomerates. He does not seem, however, to have recognised the stratigraphical importance of the break, as he considers that the newer rocks probably belong to the

* *Trans.*, vol. xi., p. 122. † *Trans.*, vol. xi., p. 12.

Millstone Grit. The officers of the Geological Survey have now shown that they are of Triassic age.

In 1897 Mr. P. Macnair read a paper on "The Physical Geology and Palæontology of the Giffnock Sandstones and their bearings on the Origin of Sandstone Rock generally."* In this paper the author deals principally with the bearings which the evidences afforded by such a group as the Giffnock strata have upon the wider question of the origin of these great courses of barren sandstones found amongst the later Scottish Palæozoic rocks, and expresses the opinion that the Giffnock rocks bore strong testimony in favour of those having been laid down under ordinary marine conditions. The stratigraphy of the rocks lying between the Holeburn Limestone and the Orchard Limestone is given in some detail; they have been subdivided as follows:—(1) Liver Rock, (2) Current-bedded Sandstones, (3) Annelid Flagstone, (4) Unconformable Sandstones.

In 1900 Mr. J. G. Goodchild contributed a paper on "The Lower Carboniferous Rocks of Northern Britain."† In this paper the author reviews the general character of the Ballagan beds as seen in different parts of the kingdom. He regards the Ballagan beds as the equivalents in time of the Lower Tuedian of Northumberland, and also of the Lower Limestone shale. He points out that there is also some reason for regarding them as the equivalents of the lower parts of the Carboniferous slates of Cork and of the Uppermost Devonian of Devonshire. Passing to a consideration of the extension of these rocks into the East of Scotland, he shows that most of the older parts of the city of Edinburgh have been built upon them. They are also to be found at Arthur's Seat, where the older volcanic rocks occur in the middle of them, the whole presenting many interesting features for geological study.

In 1901 Mr. R. W. Dron read a paper entitled "The Carboniferous Limestones of Scotland, with their Coals."‡

* *Trans.*, vol. xi., p. 199. † *Trans.*, vol. xii., p. 16.
‡ *Trans.*, vol. xii., p. 66.

In the course of this paper it is stated that about one-fourth of the coal still to work in Scotland is contained in that portion of the Carboniferous Limestone rocks which are concealed by the newer formations of the Millstone Grit and the Upper Coal Measures. A study of the geological conditions under which these coals were deposited is therefore of great economic importance. The Scottish Carboniferous series may be divided into three distinct areas, showing striking differences of deposition. The first of these consists of a strip from six to ten miles wide, which runs across the country from Girvan on the west to Elie and Dunbar on the east. The remainder of the Carboniferous Limestone series may be divided into two areas by a line running in a north-west direction from Carluke to about Kirkintilloch. To the south-west of this line we have the coalfields of North Ayrshire, Renfrewshire, Lanarkshire, and Dumbartonshire, and on the north-east those extending from Stirlingshire to Fifeshire. The stratigraphical and structural geology of the different coalfields is discussed in some detail in relation to their economic aspects.

In 1905 Mr. Peter Macnair contributed a paper on "The Geology of the Rouken Glen and its Neighbourhood."* At the outset the author explains that the object of his paper is to give such a connected account of the geology of the Rouken Glen and its neighbourhood as would be found useful to students of local geology, and in doing so to incorporate in the account the more recent discoveries that have been made in connection with the stratigraphy and palæontology of the Carboniferous Limestone series seen to the south of Glasgow. The author then describes the physical features of the Rouken Glen, pointing out that the Capelrig or Auldhouse Burn, which flows through the Rouken Glen, has its source in the Brother Loch, which is situated on the great volcanic plateau which stretches southwards and covers a large part of Ayrshire, Renfrewshire, and Lanarkshire. At

* *Trans.*, vol. xii., p. 362.

the point where the Auldhouse Burn enters the Rouken Glen, it has just ended its course over the great platform of volcanic rocks, and passes on to the Carboniferous Limestone series. Proceeding to deal with the stratigraphy of the area, it was shown by the author that there exists a group of limestones and shales lying between the Orchard Limestone and the Arden Limestone, which has hitherto usually been confounded with the Orchard Limestone, but which really lie upon a considerably higher horizon than that bed. It is proposed to call these beds the Rouken Limestones and Shales, as they are best developed in that Glen. The shales in association with these limestones are exceedingly rich in fossils, some of the rarer organisms being particularly abundant, such as *Conularia, Streptorhynchus*, and *Griffithides*, while the more common forms were often found in an exceedingly fine state of preservation. If the existence of the Rouken Glen Limestones as a separate bed be admitted, it would, of course, necessitate a considerable alteration of our present conception of the structure of the area, and Mr. Macnair pointed out what he considered to be the probable arrangement of the strata between the great boundary fault and the outcrop of the Arden Limestone. The author also describes in this paper his discovery of the exact stratigraphical position of the estuarine shale, which, with its peculiar faunas, has long been known to underlie the Arden Limestone. Outcrops of this shale were for the first time discovered by the author at Darnley and in the Waulkmill Glen.

In 1907 Messrs. R. G. Carruthers and E. M. Anderson, M.A., B.Sc., of His Majesty's Geological Survey, read an important paper on "The Stratigraphy of the Arden Basin."* They state at the outset that they found it desirable to correlate the strata of the district with a well-marked horizon, and this is furnished by the Cowglen Limestone. It is overlaid by a pebbly sandstone, for

* *Trans.*, vol. xiii., p. 134.

which the authors propose the name "Barrhead Grits." The series from the Cowglen Limestone to the Arden Limestone was described in detail, and evidence from bores and partial surface sections was adduced to show that the series was fairly uniform. It was maintained that the Rouken Glen Limestone as a separate bed was non-existent, that bed having been confounded by Mr. Macnair with the Orchard Limestone. The collected evidence was then brought to bear upon a section in the Waulkmill Glen, which shows the whole series except twelve fathoms cut out by a fault, which can be interpolated, however, from a boring in the neighbourhood. This section agrees extremely well with the evidence found in other parts of the basin, and seems to show that there is no important limestone between the Orchard and the Arden.

In 1907 Mr. John Smith contributed an important paper on "The Discovery of Upper Coal Measure Fossils in Ayrshire."* From a new pit sinking in Ayrshire a large quantity of material had been obtained, which promised to throw considerable light on the Upper Coal Measures of Ayrshire. The different rocks passed through by the pit are described in detail. Then follows a description of the lithological characters and the fossil contents of a large number of sections examined by the author. A sharp distinction is drawn between the Upper Coal Measures and the Lower Coal Measures in Ayrshire, and a number of contrasting points are given describing the differences between the two series. In conclusion, Mr. Smith describes the physical conditions under which he believed the beds to have been laid down.

* *Trans.*, vol. xiii., p. 224.

Chapter VII.

REVIEW OF FIFTY YEARS' WORK—

Continued.

Palæontology.

Ordovician and Silurian.

The Ordovician and Silurian rocks of the South of Scotland cover a large area, and are of great thickness, ranging in a continuous series from the Arenig to the Downtonian, and each charged with its own characteristic fossils. These are in some beds very abundant, and the fossils of Girvan, Moffat, and the Logan Water have long been famous and even classical.

The succession of these rocks showing their dominating fossils will be found on pages 424-5, and also at page 428 of our 1901 Catalogue, while the many hundreds of species therein recorded amply testify to the wealth of the district.

In the early days of our Society the officers of the Geological Survey practically ignored the fossil evidence, and, founding on stratigraphy alone, concluded that in the Moffat district there were some 5000 feet of strata.

These views were first given to the public in a paper in our *Transactions* by (Sir) Archibald Geikie, F.R.S., F.G.S., Director of the Geological Survey of Scotland.*

Mr. Geikie tells us that this paper was read before our Society at the request of Mr. Thomas Davidson and Professor Young, and in it he gives a digest of the state of knowledge on the subject.

This paper gives a clear and distinct statement of the case from the orthodox, *i.e.*, the Survey point of view.

* "On the Order of Succession among the Silurian Rocks of Scotland." Vol. iii., p. 74. Read 7th November, 1867.

These views were strongly contested by Mr. (now Professor) Lapworth, on the evidence of the Moffat Graptolites. He found that there was a series of beds, each characterised by different species of fossils, and that these beds were repeated again and again, and deduced from these facts that the Moffat series was not one great continuous series of beds, but a comparatively thin series, greatly complicated, reversed, and folded back on itself, and repeated again and again, and that their total thickness did not exceed 300 feet. The paper in our *Transactions* entitled "On the Silurian Rocks of the South of Scotland," by Charles Lapworth,* gives an early statement of the author's view, and was evidently regarded as heterodox by the editor, so that we have not the paper itself, but only an abstract of it, in the editor's own wording. At the same time, it will be admitted that he appears to have done his work in a conscientious manner in giving to the *Transactions* a paper in which he evidently did not himselt believe. Yet, in view of the triumphant vindication of Professor Lapworth's views, it affords a warning against the autocratic methods of editors, from which it is to be hoped that our editors, present and future, will profit, and so become wiser without being sadder men. Such as it was, however, it was welcomed by Mr. Lapworth, as at that time he was regarded as a "dangerous fanatic," and the professor has expressed his gratitude to our Society for publishing it.

Professor Lapworth gave us another paper, of which a summary appears in our *Transactions*,† but as fossils are only mentioned incidentally, it does not require to be further noticed here; it is, however, contemporary with his famous paper on "The Moffat Series" in the *Q.J.G.S.*, 1878.

Mr. Lapworth also gave us a lecture on "Graptolites" on 2nd April, 1880, an abstract of which will be found in our *Transactions* (vol. vi., p. 260).

* Vol. iv., p. 164. Read 25th January, 1872.
† Vol. vi., p. 78.

The Survey, however, were very dour, and for years refused to accept Mr. Lapworth's conclusions, and in vol. vii., p. 370, Mr. MacConnochie takes up the cudgels in their behalf, but this was about the last effort, although the discussion (p. 431) showed that even at that time (April, 1884) opinion was not unanimous.

The Survey at length yielded to overwhelming evidence, made their surveys over again in accordance with the new light, and made ample amends for the mistakes of the past in their magnificent volume dealing with the subject,* quite entitling its authors to the degree of LL.D. shortly afterwards bestowed on them. So complete has been the victory that it is pretty certain that the vast importance of fossils as indices of time will never again be questioned.

In the year 1874 our Society published a monograph on "The Silurian Brachiopoda of the Pentland Hills," with three plates, by Thomas Davidson, Esq., F.R.S., honorary member of the Geological Society of Glasgow. In it Mr. Davidson describes some twenty-five species, of which twenty species are found in Wenlock strata and ten pass up into the Ludlow rocks.

This monograph is headed "Transactions of the Geological Society of Glasgow, Palæontological Series, Part I." I regret to say that part ii. has not yet appeared, and the date of its issue is still uncertain.

Many of our Scottish species are also figured in Dr. Davidson's monograph of "British Silurian Brachiopoda."

The next writer on this subject is Mr. James Dairon, Vice-President. Mr. Dairon, who gave a great deal of time to the study of the Moffat shales and their fossil contents, used to tell an episode in his life to the following effect:—

He had a very severe attack of jaundice, and eventually the doctors informed him that they could do nothing more, and that he could not possibly live for more than three or

* "The Silurian Rocks of Britain." Vol. i., Scotland. By B. N. Peach, F.R.S., &c., and John Horne, F.R.S.E., &c. 1899.

four months. Mr. Dairon faced the matter like a philosopher; he made his will, handed over his business to his two sons, and shouldered his bag and hammer and went off to Moffat, resolved to spend the few remaining months of his life in the pleasantest manner possible, viz., in the study of his favourite science of geology. With the exception of drinking the mineral waters, he took no special steps to preserve his life, but spent his time hammering in the various localities where fossils were to be found, and not only threw off his disease, but lived to tell the tale for thirty years afterwards. So much for the health-giving virtues of fossil hunting.

His paper entitled "Notes on the Silurian Rocks of Dumfriesshire and their Fossil Remains"* is only one of numerous communications to our Society. It is illustrated by two plates of the Moffat Graptolites drawn by his own hand from specimens in his collection. Mr. Dairon also prepared models showing the structure of Graptolites very much enlarged. These were very instructive, and gave a much better idea of the structure of these organisms than could be had from ordinary specimens of the fossils themselves.

His other papers were—

"On Retiolites" (*Trans.*, vol. vi., p. 51).
"On Several New Forms of Graptolites" (vol. vii., p. 43).
"Notes on Graptolites," with two plates (vol. vii., p. 177).

This paper contains valuable information on the structure, habits, affinities, development, and relation of these forms.

"Pterygotus, &c." (*Trans.*, vol. vii., p. 197),

records its finding at a much lower horizon.

Then comes the important "Catalogue of the Western

* Vol. v., p. 176.

Scottish Fossils," 1876, in which the stratigraphy is given by Mr. Lapworth, who also supplied four beautiful plates of Graptolites. Mr. Dairon supplied information regarding the Moffat district. Mrs. Gray gave a list of the Silurian fossils in her cabinet, while Dr. Slimon revised the lists of Lesmahagow fossils, and corrected the localities for that classical district, so that it is not surprising that this part of our catalogue should have had such a wide reputation.

First and foremost of all the Silurian workers comes our hon. member, Mrs. Gray,* whose grand collection of Girvan fossils has formed the theme of many papers, chief among which is one entitled "A Monograph of the Silurian Fossils of the Girvan District in Ayrshire," with special reference to those contained in the Gray collection, by H. Alleyne Nicholson, M.D., &c., and Robert Etheridge, Jun., F.G.S., &c., 1878 to 1880 (W. Blackwood & Sons). This work appeared in three parts or fasciculi, and dealt with the Protozoa, Actinozoa, Crustacea, Annelida, and Echinodermata, and is illustrated by twenty-four plates of fossils. It forms vol. i., but, unfortunately, vol. ii. has never appeared.

The work has, however, been taken up by the Palæontographical Society, who have issued "A Monograph of the Lower Palæozoic Trilobites of the Girvan District, Ayrshire," by F. R. Cowper Reed, M.A., F.G.S., 1903-6. This monograph is founded chiefly on Mrs. Gray's specimens, together with those in the museums of London, Cambridge, Edinburgh, and Glasgow.

This work gives an exhaustive account (as far as the materials will permit) of this interesting subject, and is illustrated by twenty plates of fossils.

The accumulation of this great collection has been the work and hobby of a lifetime, and Mrs. Gray appears as enthusiastic as ever. Long may she be spared.

* Mrs. Gray is the wife of the late Mr. Robert Gray, F.R.S.E., author of "Birds of the West of Scotland," and numerous notices of specimens exhibited are to be found in *Proc. Nat. Hist. Soc., Glasgow*, vols. i. and ii.

Palæontology.

We are also favoured with three papers by Mr. David Forsyth, viz.:—

"On the Muirkirk District" (vol. vii., p. 74).
"On the Girvan District" (vol. vii., p. 358).
"On the Carsphairn District" (vol. ix., p. 376).

These are very useful papers, giving localities, positions, and principal fossils of the various beds, and, being accompanied by sketch maps, form excellent guides to the districts.

Our *Transactions* also contain a record of the first discovery of Radiolarians weathered out and detached from the rocks in which they were embedded.*

The Logan Water.

There is no more interesting district in the Silurians of Scotland than that of the Logan Water, and the history of discovery in that part of the country reads almost like a romance, but, as that will be detailed as part of the biographies of Dr. Slimon and Dr. Hunter, it is unnecessary to repeat it here.

Of the great Crustacea, our catalogue gives a list from the Ludlow beds of eleven species belonging to the Phyllocarida, ten to the Eurypterids, and one to the Xiphosura, besides a Scorpion and a Myriapod, while the Downtonian beds contain nine large Crustacea, besides a Scorpion and a Myriapod, these two latter not being named. Some of these Crustacea measured nearly 4 feet in length, while fragments indicate still larger dimensions. There are, besides, many fossils belonging to other classes, but the above and the fishes may be considered as the peculiar pride and property of the Logan Water.

Dr. Thomas Davidson, at the close of the "Monograph on the Pentland Hills Brachiopoda," describes two Brachiopods from Logan Water, one, *Lingula minima*, he considers characteristic of the Downton Sandstone; the other is a single valve of a *Rhynchonella*, to which he

* John Smith. *Trans.*, vol. xi., p. 24.

does not give a name, as only one specimen had been found.

Our catalogue now contains ten species of Brachiopods, four being found in the Logan Water and six in the Hagshaws.

FISHES.

It does seem strange, when we consider the great amount of searching that must have taken place in these strata, that down to the death of Dr. Hunter the presence of fish was not noticed, the only reference being by Dr. Hunter in 1883—"Here also we found a few fish scales something like those of Acanthodean fishes."* Yet it would appear that the "Slimon" collection contains imperfect specimens of *Thelodus* and *Birkenia* from the Ludlow beds of Logan Water. As these are not labelled, there is no evidence that Dr. Slimon recognised them as fish remains. The "Young" collection at Kelvingrove also contains a microscopic slide of scales of *Thelodus Scoticus.*

Mr. Macnair tells us† that "there cannot, however, be the least doubt that the merit of renewed attention having been given to the fauna of these beds is due to Mr. James Young, of Lesmahagow, who in the year 1896 discovered an entire fish of the genus *Thelodus* in the upper reaches of Logan Water."

Still it was not till the collectors of the Survey, Messrs. MacConnochie and Tait, took up the work that fishes were really recognised, the first announcement being in the Survey annual report of progress for the year 1897, and they have been further referred to in several following reports. The specimens were handed by the Survey to Dr. Traquair, who issued two reports on them in the *Transactions* of the Royal Society of Edinburgh, 1899 and 1905.

It was not long, however, before an enthusiastic band of workers belonging to our Society took up the work, under the leadership of Mr. David Nimmo, and in the

* *Trans.*, vol. vii., p. 274.   † *Trans.*, vol. xii., p. 206.

year 1899 erected a new camp on the Logan Water. Thither resorted many of our members during holidays or spare times in the summer, and the flag with the ensign "Camp Siluria" has been kept flying during the summer from that day to this. The result has been the collection of very many specimens (most of which have been presented to the Kelvingrove Museum) and great increase of our knowledge of these interesting beds, all as racily described by Mr. Macnair.*

The result is that Dr. Traquair has described nine species of fish, all new to science, belonging to four genera, of which three are new, there being in all eight species in the Downtonian and two species, besides "fish remains indet," in the Ludlow beds.

The interest of these fishes is very great. They are the earliest vertebrate remains known in which the structure can be made out, and from their very primitive character throw great light on the knotty (or fishy) problems of evolution.

In consequence of these discoveries, these beds, which were formerly tacked on to the Old Red Sandstone, are now considered to form the highest division of the Silurian system in the South of Scotland. As showing the importance of fossils in stratigraphy, it is interesting to notice that Dr. Davidson, from the study of a single Brachiopod, was able to state the correct position of these beds some thirty years before the Survey came to the same conclusion.

Old Red Sandstone.

A considerable area within fifty miles of Glasgow is covered by these rocks, both the Upper and the Lower divisions being represented.

They are, however, remarkably unfossiliferous; only at very few and widely scattered localities have fossils been found, and these generally in a very poor condition. Our catalogue of 1876 gives a list of these, but it is to be remarked that the locality (Carmichael Burn) from

* *Trans.*, vol. xii., p. 203.

which *Graptolites*, *Dithyrocaris*, and *Orthoceras* were obtained is Silurian and not Old Red.

The following are, so far as we are aware, all the fossils that have hitherto been recorded, with the necessary references:—

Psilophyton? *Dawson.*
Buchanan Castle Quarry near Drymen.
Old Quarry at Small Reservoir near Kilmahew.
Quarry in Cameron Plantation near Alexandria.
Turnpike Road at Over Balloch, Loch Lomond.

See "Plants in the Lower Old Red Sandstone in the neighbourhood of Callander," *Q.J.G.S.*, 1876, by Messrs. R. L. Jack and R. Etheridge, jun.

Psilophyton found at an excursion of Sir A. Geikie's students in 1882 (*Nature*, vol. xxvi., p. 39) in the Allt Mor Burn, north of the String Road, Glen Shurig, Brodick, Arran.

The Geological Survey also report the finding in 1897 of *Psilophyton princeps*, var. *ornatus*, Dawson, in the Glen Shurig Burn, Brodick, Arran, about 100 yards and 200 yards above its junction with the Allt Mor, which is its principal tributary on the south side. The fossils were found in a good shale band 3 inches thick on the south bank of the stream, and are supposed to be from a horizon several hundred feet lower than the 1882 specimen. The above are Lower Old Red.

See Survey Memoir, "The Geology of North Arran, South Bute, and the Cumbraes, &c.," pp. 23-24, 1903. (Sheet 21.)

The same publication also gives the following localities from which fossils have been obtained by the Geological Survey (pp. 153 to 155):—

Locality Number.

LOWER OLD RED SANDSTONE.

23. South Glen Sannox Burn at footbridge, about half-mile from mouth.

43. Glen Rosie, about one mile west of Glen Rosie Cottages, at streamlet descending hill slope on the south side of the Glen, not far from junction with schist.

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UPPER OLD RED SANDSTONE.

24. Sannox Shore, about quarter mile south of Farchan Mor.

They do not, however, give any indication of what the fossils were, and the above is, so far as I have observed, verbatim the whole of the information given on the subject.

PISCES.

Cephalaspis, Agassiz.
Lyelli, Ag.
Tulloch, near Lanfine. Sorn district of Ayrshire. Lesmahagow.*

Bothriolepis leptocheirus Traquair.
Heads of Ayr in red micaceous flagstones on the beach.

These remains were formerly recorded as *Pterichthys major.*

ADDENDUM.

Our *Transactions*, vol. x., p. 323, contain an interesting paper by Messrs. James Reid and Mr. Peter Macnair on the genera *Lycopodites* and *Psilophyton* of the Old Red Sandstone. In the opening section of the paper the authors gave a *résumé* of their views upon the stratigraphical succession of the Old Red Sandstone of Scotland, showing that the plant, as well as the piscine and crustacean, evidence is strongly in favour of a return to the old triple division of these rocks given to them by Sir Roderick Murchison. While, on the one hand, the sandstones of Perthshire and Forfarshire hold abundant, though fragmentary, remains of *Parka decipiens*, *Zosterophyllum*, *Pachytheca*, *Arthrostigma*, and *Psilophyton*, the latter was the only genus which ranged upwards into the Caithness series, these beds holding a quite distinct suite of plant-remains, approaching more nearly to a Carboniferous facies, such as *Lycopodites*, forms of *Calamites* and

* *Trans.*, vol. viii., p. 162.

Lepidodendron, ferns, and conifers. The whole evidence apparently points to the fact that these Caithness rocks occupy a distinct and higher horizon than the Perthshire and Forfarshire sandstones. In the next and main part of the paper the authors contended that the plants *Lycopodites* of Salter, and *Psilophyton* of Dawson, must be definitely referred to the two distinct genera founded by these authors respectively, though Carruthers and Kidston had subsequently reduced the genus *Lycopodites* to a species of *Psilophyton*. There seemed to be ample evidence to uphold the difference of genera in the leaves, fruit, and general characters, and there was also the entire absence of any trace of *Lycopodites* from the sandstones of Perthshire and Forfarshire, although these strata contain remains of *Psilophyton* in abundance. The character of *Psilophyton* is distinctly woody, while that of *Lycopodites* is more herbaceous, and the leaves (so-called) of the former are hard and spinose, or thorn-like, while the latter has true lanceolate leaves. The fruit of *Psilophyton* occurs in terminal spore-cases, while in *Lycopodites* it is sessile and globular.

In 1897 the same authors, along with Mr. W. Graham, read a paper "On the Origin and Affinities of *Parka decipiens* of Fleming."* The paper gave first a summary of the different views as to the animal or vegetable nature of this organism since its discovery by Dr. Fleming, of Edinburgh, about sixty years ago, put forth by Lyell, Hugh Miller, Page, and Peach, up to the quite recent researches carried on by Sir William Dawson and Professor Penhallow, of Montreal, these latter being based upon a large series of specimens supplied by the present authors. The general distribution and position of the beds containing *Parka decipiens* in Fifeshire, Perthshire, and Forfarshire were then reviewed, with the bearing which the distribution had upon the important question relating to the contemporaneity of the Caithness and Central Scottish areas of the Old Red Sandstone deposits,

* *Trans.*, vol. xi., p. 105.

and a return to the old classification which placed the Caithness rocks upon a distinct and higher horizon, and later in time than those of Central Scotland, was strongly advocated. The authors next dealt with the origin and affinities of *Parka*, showing the difficulties under which palæo-botanists worked amongst the plant-remains of the Old Red Sandstone rocks, owing to their extremely fragmentary condition. For instance, they only knew of three examples—amongst a very large series of specimens passed through their hands—in which the stems and fruit appeared in actual organic contact. After a general and microscopic description of the organism, the authors concluded by stating that they fully confirmed the conclusions arrived at by Dawson and Penhallow in the undoubted plant affinities of *Parka decipiens*, and assigned it to the group of Rhizocarpeæ. The paper was illustrated by a large series of hand and microscopic specimens, and by diagrams, drawings, and maps. (EDIT.)

CARBONIFEROUS.

Introduction.

The area covered by the following paper is that of the West of Scotland, and is nearly all included in the Clyde drainage area. It does not include Liddesdale, the Lothians, or Fife.

Frequent references are made to similar strata outside these limits, but when no such reference is made the remarks only apply to the district under consideration, and do not imply that similar conditions prevailed outside these limits.

Situated as we are in the centre of a mining district, in which not only coal and iron, but also lime and Roman cement were largely wrought,* exposing strata rich in

* I regret that recent economic changes have altered this state of affairs. Roman cement is no longer worked, having been displaced by Portland cement, and limestone to a considerable extent by the purer and cheaper mineral of Wales and Ireland.

fossils, it was inevitable that the study of fossils should be strongly taken up from the very beginning of our Society's existence.

The very first paper printed in our *Transactions*, viz., "On the Geology of the Campsie District," by John Young, contains a list of fossils in which each is assigned to its own bed, and the position of the beds, as far as possible, indicated.

This paper, which has gone through three editions, may be taken as a favourable type of numerous other papers, which, however, as a rule, deal with rather smaller areas, so that now we have the contents tabulated of nearly all the known beds of fossils.

A strong impetus was given in this direction during the early days of our Society's existence by the fact that the late Thos. Davidson, LL.D., was at that time engaged in issuing for the Palæontographical Society his great work on the "Brachiopoda," and was preparing for the Carboniferous volume.

A lengthy correspondence was entered into between him and various members of our Society, which resulted in his issuing, chiefly, as he tells us, on the suggestion of Mr. John Young (afterwards LL.D.), a paper entitled "The Carboniferous System of Scotland characterised by its Brachiopoda," which he dedicated to this Society.*

This paper, which is illustrated by five double plates, contains figures and descriptions of some forty-nine or fifty species, being all that were then known in Scotland, and considerably less than the number found in either England or Ireland.

This is the most useful monograph for the members of our Society (especially the young members) that has ever been published, and much greater progress would have been made had we been possessed of monographs of the other divisions on similar lines.

Although we have no such record, it may be taken for

* *The Geologist* from December, 1859, to July, 1860. This paper was afterwards published separately from *Geologist* Office, London. It is now very rare and much prized.

granted that other divisions of fossils were collected and tabulated with equal assiduity.

Dr. Davidson was not the only scientist with whom our members were in correspondence, and vol. ii. of the *Transactions* contains a list of the "Entomostraca of the Carboniferous Rocks of Scotland," by Professor Rupert Jones and James W. Kirkby. This list was compiled from specimens collected, arranged, and mounted by members of this Society, and sent to the above gentlemen. These were afterwards embodied in their monograph on Carboniferous Entomostraca for the Palæontographical Society.

We have also in this volume an important paper by Dr. Henry Woodward on some Carboniferous Articulata, with one plate of fossils; and we have, besides, two plates of fossils illustrating further discoveries by our ordinary members.

About this time it appears to have been the ambition of our members to have monographs of all the Scottish fossils published similar to Dr. Davidson's Scottish Brachiopoda, but this turned out to be a task unsuitable to men who were tied to business, with comparatively few and short holidays, so that it was never carried out, the only other monograph published by our Society being one on "The Silurian Brachiopoda" of the Pentland Hills, by Dr. Davidson.

James Armstrong.

The leading palæontologists of our Society in these early days were John Young, James Armstrong, and James Thomson. (As notices of Mr. Young and Mr. Thomson are being prepared by others, it is unnecessary that I should dwell on them here.)

Messrs. Young and Armstrong collaborated to a considerable extent, and it is difficult to disentangle the work of the two, and no good could come of it even if it were done; but I am inclined to award the palm to Mr. Armstrong as the leading palæontologist of our Society.

Review of Fifty Years' Work.

James Armstrong was born at Leith, but was educated at the Normal School in Glasgow, where at an early age he was sent into a business office. He had from his youth a keen desire for study, and joined the evening class at Anderson's College, Glasgow, under Dr. Taylor, Professor of Natural History.

So great was his enthusiasm that he conceived the idea of getting a powerful lamp by which he might be able to search such get-at-able places as Orchard when the shortness of the day made it impossible on account of his business to do so in daylight. Needless to say, this ended in failure.

Another story illustrating his enthusiasm is that one day he called on Dr. Rankin, of Carluke, asking directions about Gare and Westerhouse, which he proposed to visit that day. In conversation, it transpired that he had already visited Lesmahagow and Brockley, and had walked across to Carluke, and the doctor exclaimed, "Sir, your name is Armstrong; it ought to be Legstrong."

Mr. Armstrong acted for some years as Librarian and Curator of the Society's museum, and afterwards became Secretary. The museum, it may be stated, now forms part of the Kelvingrove Museum.

Mr. Armstrong also described a number of new species of local fossils, most of which, I am pleased to say, have stood the test of time. He also entered into correspondence with the leading specialists of the day, with the result that our *Transactions* have been enriched by contributions on our local fossils from several of these gentlemen.

But the work by which he will be best remembered is his catalogues. The first of these was published as a Supplement to vol. iii. of our *Transactions*, and is dated 1871. It forms part of a joint paper with Mr. Young, to which that gentleman contributed the literary part, while Mr. Armstrong (as is stated in the title) contributed the "Catalogue of the Fossils" and an index to their principal localities.

It is impossible to speak too highly of this work. The

James Armstrong.

labour connected with it must have been immense, while its importance can hardly be over-estimated. It can only be regarded as a splendid piece of work, creditable alike to the authors and the Society. It was in great demand, and has been out of print for many years, in fact, almost immediately after its publication.

The Second Catalogue.

In the year 1876 a second catalogue was prepared, in view of the meeting of the British Association in Glasgow in that year. It was designated "Catalogue of the Western Scottish Fossils," compiled by James Armstrong, John Young, F.G.S., and David Robertson, F.G.S., &c.

It covers the whole of the West of Scotland from Skye and Raasay on the north to Girvan and Moffat on the south.

The scope of the work and the position of the various workers will best be shown by the following abstract from the preface:—

> "That (*i.e.*, the 1871) list has been brought down to the present time, and the geology of the vaguely designated 'West of Scotland' completely represented by newly prepared lists of fossils, obtained from all the deposits from the Silurian to the Glacial included. No one who has not tried it knows the labour such lists involve, but those who have tried it can estimate the continuous labour which Mr. Armstrong has bestowed on the work, and the care with which Mr. Young and he revised the proof sheets, itself no light task.
>
> "Mr. Young prepared the preliminary sketches of the Old Red, Carboniferous, and Permian formations, and notes on the distribution of the Carboniferous fossils. Mr. David Robertson has supplied a great want by his complete list of Glacial fossils."

Then follows a list of names, from which it is apparent that, while Mr. Armstrong had the assistance of numerous willing workers, still the work as it stands was essentially his own, and that, in addition to the drawing up of the lists and localities, he had also to conduct a voluminous correspondence with these various parties.

In comparing these catalogues we must bear in mind that the older one contained only Carboniferous Fossils, and that the newer one embodied the fresh light which had been thrown on the subject in the interval, together with correcting errors which are common to all first editions, but which were remarkably few in the one in question.

When proper allowance has been made for these, we have no hesitation in setting down the older as by far the finest piece of work, due principally to the fact that in it the authors were given a free hand, so that they could give an extended list of localities for each fossil, showing not only its geographical distribution, but also its range in time and short explanatory notes. The second catalogue was so restricted that only one line was allowed for each species, so that it becomes practically worthless as a guide to the life-history of any particular species.

Still, even with these defects, it was a most valuable book, and I have been informed that the staff of the Geological Survey always considered it a necessary equipment in the districts of which it treats.

Mr. Armstrong afterwards went to America, and died at Brooklyn on the 28th November, 1892. He possessed a very fine collection of fossils, which is now in the Royal Scottish Museum, Edinburgh.

Unlike the first, there were many who had a hand in the preparation of this second catalogue, and in reading over the names in the preface we are struck by the large proportion who have now gone over and joined the majority. Among the names are those of John Young, LL.D.; James Armstrong, David Robertson, James

Dairon, Dr. Slimon, Dr. Rankin, Dr. Grosart, Robert Craig, James Linn, A. Patton, James Bennie, James Thomson, James Bryce, LL.D.; Thomas Davidson, LL.D.; D. C. Glen, Professor John Young, M.D., whose faces we shall see no more, and can only trust that others will arise to worthily fill their vacant places.

THE THIRD CATALOGUE,

entitled "The Geology and Palæontology of the Clyde Drainage Area," was prepared for the meeting of the British Association in Glasgow in 1901. It is larger than the others, and is restricted to the Clyde drainage area. It was prepared on the lines of the Second Catalogue, and was, in fact, that work brought up to date, and suffers from the same defect, viz., that to keep down expense only one line was to be allowed to each species. Fortunately, some of the compilers rebelled against this rule, and refused to do the work unless more space was allowed. It is too early for us to say much about it. It would be like blowing our own trumpet, and I must refer readers to the book itself.*

In the early days we were favoured with a remarkable series of papers by Mr. Robert Craig, of Beith, among which are the following:—"Sketch of the Carboniferous Basin of Dalry, Ayrshire" (vol. iii., p. 271); "First appearance of certain fossils around Beith and Dalry" (vol. v., p. 36); "Fossils of the upper series of the Lower Carboniferous Limestones in the Beith and Dalry Districts" (vol. vi., p. 1); "Fossiliferous Strata lying between the Lower and Upper Limestones in the Beith and Dalry Districts" (vol. vii., p. 86); "The Upper Limestones of North Ayrshire" (vol. viii., p. 28); "A new Railway Cutting near Beith" (vol. ix., p. 65).

In this series of papers Mr. Craig sought to give a complete list of fossils occurring in each bed in his own vicinity, and as the beds in Scotland are, as a rule, thin,

* It was rebound in special form, with additions, and published by our Society in 1904, and may be had interleaved.

and violent fluctuations occur in the fauna of the different beds, this was a work of great labour and importance, covering, as it did, the whole of the Lower Carboniferous series in that part of Ayrshire.*

Another very energetic worker was the late Mr. James Thomson, whose magnificent collection of Scottish Carboniferous Fossils now adorns the Kilmarnock Museum. It contains, among other things, a most remarkable collection of Carboniferous reptilian remains, and what is probably the finest collection of cut sections of Carboniferous corals in existence.

Mr. Thomson, who latterly specialised in Corals, published his researches in the *Transactions of the Glasgow Philosophical Society*, vols. 1877 (3 plates), 1878 (3 plates), 1879 (3 plates), 1880 (3 plates), 1881 (4 plates), 1882 (7 plates), 1883 (14 plates). He also wrote several important illustrated papers for the Royal Irish Academy, while his latest papers on the subject, illustrated by three plates, are in our own *Transactions* (vol. xi., pp. 1 and 51). To sum up, Mr. Thomson may be said to have given, besides letterpress descriptions and woodcuts, over 60 plates of illustrations, all of them engraved on copper by his own hand, and mostly from transparent sections now in the Kilmarnock Museum.

In making the illustrations the sections were photographed on copper plates, and were then engraved by his own hand. This method was invented by himself, and one cannot but be astonished at the extent, beauty, and minuteness of the various figures. It must have been a labour of the strongest love. He also secured a large number of reptilian remains, and his collection probably contains as many of these as all the museums of the country put together.

Mr. Thomson's energies were not, however, confined to Corals, and his papers on the geology of Campbeltown, Islay, and the North Coast of Arran, and on Carboniferous

* Mr. Craig's collection, which was confined to Beith and Dalry, has now passed into the hands of the writer, and the duplicates to the Kelvingrove Museum.

fish remains, will keep him in remembrance outside of Corals.

An important contribution to our knowledge was made by the late Dr. Hunter in two privately printed papers, the first entitled "Vertical Section of Carboniferous Strata, West of Scotland, by Dr. Hunter, Daleville, Carluke, Corresponding Member of Geological Society of Glasgow, &c." It contains a list of 642 different beds, each bed being numbered and the thickness given, distinguishing also those beds which contain fossils.

Part ii., entitled "The Palæontology of the Carboniferous Strata, West of Scotland," gives a separate list of fossils for each bed.*

Although he gives his papers as "West of Scotland," it would have been more correct to have styled them, "Carluke Parish and Neighbourhood." He states—"Nearly the whole of the genera and species enumerated are in the Braidwood collection, formed by Dr. Selkirk, Carluke, and myself. Part iii., to be issued soon, will contain a series of plates of new and rare species in the collection." Unfortunately, this part never was issued.

Dr. Hunter (who afterwards assumed the name of Dr. Hunter-Selkirk) presented his extensive collection of fossils and minerals to Kilmarnock Museum.

At one time a strong effort was made to divert the palæontological papers from our Society to the Natural History Society, and quite a number of good papers are to be found in that society's *Transactions*, yet it is pretty safe to say that no interest was ever taken in the subject by any of its members who were not at the same time members of our Society, and the heresy may now be said to have died a natural death.

The usefulness of all our lists is greatly marred by the unsatisfactory state of the science of Palæontology, the constant alteration of names, and the fact that many of our forms have no fewer than eight or ten synonyms. However, it is to be expected that in course of time, as

* Printed by Andrew Beveridge, High Street, Carluke, 1875.

monographs of the various classes appear, this will gradually right itself, still it is questionable whether even the youngest of us will live to see that day. It seems to me that our next catalogue will require to be a bilingual one, giving the old names with their modern equivalents, as otherwise much good work will be incomprehensible to our future members.

The monographs published by the Palæontographical Society are of the greatest use, and in the preparation of these our members have taken a prominent part, and most of these memoirs would have been considerably shorter but for their assistance.

The late John Young, LL.D., was for many years a very cornerstone of our society, and, although the notices of, and papers by him are abundant, they give but a poor idea of the work he did or of his influence in our Society, as for many years he was the leading figure and indispensable to its welfare.

He was a good all-round man, and an authority on West of Scotland fossils. He also specialised on Entomostraca and Polyzoa, and a considerable number of papers on the latter subjects are to be found in our *Transactions* (vol. v. to vol. x.), and several others in the *Transactions* of the Natural History Society of Glasgow. The writers of monographs for the Palæontographical Society also received his enthusiastic support, as will be seen especially in the works of Thomas Davidson, Woodward and Jones, Jones and Kirkby, and Wheelton Hind.

He worked a great deal with the microscope, and threw light on many obscure points which had hitherto escaped notice or been wrongly interpreted—

> He was a man, take him for all in all,
> We shall not look upon his like again.

Mr. John Smith—the father of our Society—has all along been a valued worker, and no man has done more good work than he, as nearly every volume can testify. Although he knows as much and has worked as much as and probably more among

fossils than any member of the Society, yet his communications on this branch of science are not nearly so extensive as could be wished. In this branch, at least, he is more of a worker than a writer, and one has to consult the Carboniferous monographs of the Palæontographical Society to have any idea of what he has accomplished. He discovered sponges and conodonts, and also a series of microscopic plants, which he has placed under the doubtful category of *incertæ sedis*.*

He also discovered fossil footprints in the lower red rocks of Ayrshire,† and is, I understand, presently engaged in preparing an important memoir on a new and extensive series of fossil footprints he has discovered, and which, we trust, will shortly see the light.

Our *Transactions* are also adorned with numerous papers on local strata and fossils by, among others, Messrs. M'Phail, Hunter, Patton, Coutts, and Dunlop, while descriptions of fossils appear from Woodward, Jones, Traquair, and Kidston.

Results.

Taken as a whole, our strata may be regarded as highly fossiliferous, nearly all the divisions being well represented, and we have several groups which may be regarded as almost peculiar to ourselves.

Many fossils, especially those found in the shales, are beautifully preserved, having undergone less alteration than those of England and Ireland, so that the minutest details can often be made out. Our corals appear to show finer structure, being less crystallised than those of our neighbours, while it is not uncommon to find the mother-of-pearl lustre in many of our shells.

In Brachiopoda we are deficient in the number of species, but we abound in the remains of marine fishes, mostly cestraciont, among which the Kilbride beds are famous for their specimens of *Psephodus magnus* (one specimen containing teeth which had been referred to

* Vol. x., p. 318. † *Trans.*, vol. x., p. 201.

three genera and five species), *Cladodus Neilsoni*, *Janassa Wysei*, *Acrolepis Hopkinsi*, &c., while I think we may fairly claim the largest fish remains ever found.

Briefly stated, the result of our researches showed that in the West of Scotland the transition between the Upper Old Red Sandstone and the Carboniferous was very tranquil, and the division line has had to be frequently shifted, the finding of a few fish scales of Old Red Sandstone or Carboniferous types being the only distinguishing feature in several of these Red Sandstones.

That there was, however, a decided change is shown by the finding in Arran of Carboniferous fish and plant remains a few feet above the previously recognised boundary of the Old Red Sandstone.

This period was succeeded by a long period represented by very numerous thin beds of shale and cement stones, known as the Ballagan beds, and almost entirely devoid of fossil remains.* These beds were probably laid down in lakes containing solutions inimical to life.

This period was succeeded by one of great volcanic energy, the greater part of our district having been covered by volcanic débris many hundreds of feet in thickness. There were, however, long-continued periods of quiescence, during which we have our first evidence of land conditions in the forests interbedded with the volcanic rocks, the structure of the trees being very beautifully preserved for microscopic examination.

This fact was first brought out by the late Mr. Wunsch, vice-president of our Association, who found a forest of this description in Arran.† Several of his specimens were found to be new to science, and are described in the Palæontographical Society's *Transactions*.

Later on Dr. John Young, Vice-President, found similar beds in the Kilpatrick Hills (*Transactions*, vol. iv., p. 123), and they have also been found at Pettycur, near Kinghorn, in Fife.

* Dr. B. N. Peach states that he has found Entomostraca in some of the Campsie cement stones.

† *Trans.*, vol. ii., p. 97.

We have thus evidence of a forest extending the whole breadth of Scotland, and destroyed by volcanic outbursts, but we are, as yet, without evidence as to whether this great forest was contemporaneous, and destroyed by the same catastrophe.

To such an extent did forests grow that at Bowling there exists a coal seam which was formerly worked, although covered by hundreds of feet of trappean rocks (*Transactions*, vol. ii., p. 149).

The contrast between this state of matters and that in the East Coast of Scotland and in the South is very great.

In Fife there are numerous marine beds charged with abundance of fossils, and in the Lothians there are not only marine beds, but the important fish-bearing beds of Wardie and Burdiehouse; and there are, besides, the rich oil shales, which have contributed so greatly, not only to the fossils, but to the wealth of that region, while in the south we have the Eskdale beds, charged with characteristic marine and fresh-water fossils, all of which are absent from the west, where we have not a single trace of marine life or marine deposit of any kind.

The contrast was even greater with England and Ireland, which appear to have been covered by the ocean and engaged in the formation of the lower part of the Mountain Limestone series.

About the only fossiliferous bed we have, belonging to this period, is that found on the shore between the river Doon and the Heads of Ayr, containing poorly preserved shells resembling *Anthracomya*, a few fish scales; several entomostraca and *Spirorbis carbonarius*, and a thin layer almost composed of the crushed shells of *Spirorbis helicteres;* apparently indicating the existence of fresh-water conditions beyond the southern limit of the volcanic area.

Some idea of the immense time occupied by these volcanic forces may be had by comparing our strata with those in the neighbourhood of Edinburgh.

According to the late Mr. Goodchild,* these are—

LOWER LIMESTONE SERIES.

9.	Lower Limestone Series :—	
8.	Oil Shale Series to the Burdiehouse Limestone at Broxburn and West Calder, ...	2400 feet.
	(See H. M. Cadell, *T.E.G.S.*, vol. viii., p. 136.)	
7.	Strata between the Burdiehouse Limestone and the Pumpherston Shale, ...	800 „
6.	Sandstones and Shales of Hailes and Redhall, ...	500 „
5.	Wardie Shales in Craiglockhart cutting, ...	480 „
4.	Granton Sandstone, ...	850 „
		5030 feet.

3. Upper Ballagan beds or Abbey Hill Shales.

As beds No. 8 to 4 (inclusive) are all but absent in our district, we have a period of time represented by some 5000 feet of strata occupied by our volcanic rocks, the Craigmaddie Sandstones, and possibly the top of the Ballagan series.

LOWER LIMESTONE SERIES.

Our next change brings us into the Lower Limestone series, and near the bottom of it we find the great development of *Productus giganteus,* which gives us an equivalent horizon with the strata of England and Ireland.

Here, again, we note the tremendous difference between the conditions prevailing in Scotland and the rest of Britain. While in the Midlands and South of England and in Ireland from this point up to the Millstone Grit the conditions were mainly oceanic, in Scotland we have a continual alternation between land, fresh water, estuarine, muddy bottoms, and clear oceanic conditions resulting in limestone.

* Further remarks on some recent exposures of Rock in Edinburgh.—*Trans. Edinburgh Geological Society,* vol. viii.

Palæontology.

Using the words of the poet, we might say of our strata, they are

> . . . deceivers ever,
> One foot in sea and one on shore,
> To one thing constant never.

Our limestones (which are less than one-tenth the thickness of those of England or Ireland) occur mostly in thin beds (the thickest being about 40 feet, and that only local), and are nearly all underlaid by a bed of coal, generally sulphurous and containing plant remains in a pyritised state.

This represents a land surface, and as the land began to sink it made way for a muddy shale, sometimes barren, and, as the sinking increased, the mud disappeared and its place was taken by limestone. After a time the sea bottom rose, and the above process was repeated again and again, with the addition of beds of sandstone and fireclay, which is the soil on which the coal plants grew.

In one case it may be said to have been caught in the act, beds with fresh-water fossils having been invaded at intervals by myriads of marine fry about one-eighth of an inch long (the adult shell, *Actinopteria persulcata*, growing to about 1½ inches long), but before this fry could grow to maturity the marine conditions had disappeared, and the fresh-water fossils again abounded.*

The position of this bed is under the Arden Limestone, near the top of the Upper Limestone series.

It has been suggested that as the spring tides of the vernal equinox are the highest in the year, and at that time the sea is charged with floating fry, this may explain the phenomena of this invasion.

We have also at least two beds showing estuarine conditions. By estuarine is not meant conditions such as prevailed in Upper Carboniferous times, when the beds contained no marine fauna, but a fauna entirely different, with not a single form found in marine beds. We know of three distinct faunas living at the present

* *Trans.*, vol. ii., pp. 71, 72; vol. ix., p. 79; vol. xii., p. 294; also "Summary of Progress of the Geological Survey for 1906," p. 108.

day—1st, land; 2nd, marine; 3rd, fresh water—but we know of no estuarine fauna. What we now call estuarine would give a mixture of marine and fresh water, and also probably of land forms in the same bed.

The first of these estuarine beds is between the lowest coal and the lowest limestone in the Beith district, and contains, among typical marine remains, those of Megalichthys Hibberti, and Strepodus. This bed extends into the Lanarkshire field, but there contains only marine remains. But a bed at about the same horizon occurs at Abden, Kinghorn, in Fife, exhibiting estuarine conditions to a much greater extent.*

Quite a typical estuarine bed is that lying over the Calderwood cement at East Kilbride, in which we find, among others, the following genera of—

MARINE FOSSILS.

Archaeocidaris, *Dithyrocaris*, *Productus*, *Rhynchonella*, *Nuculana*, *Posidonomya*, *Orthoceras*, *Nautilus*, and the fishes *Psammodus*, *Psephodus*, *Cladodus*, *Janassa*.

FRESH WATER FORMS.

Anthrapalaemon.
Fishes—*Elonichthys*, *Eurynotus*, *Acrolepis*, *Megalichthys*, *Rhizodus*, *Amphicentrum*, *and Cœlacanthus*.

LAND FORMS.

Lepidodendron, *Sphenopteris*, *Adiantites*, *Rachopteris*, *Eoscorpius*, *Glyptoscorpius*, and a Millipede.

LIMESTONE FOSSILS.

Although there are one or two fresh-water limestones with characteristic fossils, yet the great majority of our limestones are marine.

One bed consists almost entirely of shells, and there are some thin beds of encrinites, also one or two beds of *lithostrotions* and other rugose corals, yet with these exceptions the limestones are, as a rule, not very fossiliferous, and the forms we get are mostly the same as those found in the shales, so that if the limestone fossils were

* *Trans. Edinburgh Geological Society*, vol. v., pp. 310 and 314.

excluded the list would not be materially reduced. The fossils (other than those noted above) consist mainly of crustacea, polyzoa, shells, and shark's teeth. Some very pure limestones contain large species of entomostraca (*Entomoconchus*, &c.), also polyzoa finely preserved. Lamellibranchs are rare. Foraminifera and sponges are common in certain limestones.

Our limestones range from almost absolute purity through "hydraulic and Roman cement," till it becomes a question whether a particular bed is a limestone or a calcareous shale. The cement limestones are very fossiliferous, but the fossils, as a rule, are not readily observable, and it is only in half-burnt or highly weathered specimens that we get to recognise their original richness.

Marine Shales.

These range through all grades, from those that have accumulated slowly in comparatively clear waters and are crowded with fossils, through all degrees of muddiness, depth, and brackishness, till gradually, one after the other, the various groups die out, and the shales appear to be altogether devoid of life.

It is very interesting to trace these grades, and to put each separate bed into its own position in this respect, as the grouping of the fossils varies with the purity and depth of the water.

First, nearly all the corals disappear, then the crinoids and polyzoa become fewer and smaller, and finally disappear. Nearly all the brachiopods follow in turn, but the cephalopods hold their position remarkably well, while up to a certain point the lamellibranchs and gasteropods increase in numbers.

As the proportion of fresh water increases, various forms, one after the other, disappear, till they are reduced to a small group including *Lingula*, *Discina*, *Nucula*, a dwarfed *Bellerophon*, a small *Goniatite*, and an *Orthoceras*.

As we proceed still further, these gradually disappear, till we are left with only *Lingula* and *Discina*, which appear to be able to survive in water so fresh as to kill off all other forms of marine life. In fact, *Lingula squamiformis* thrives and attains the greatest dimensions in water so fresh that no other marine organism could exist in it.

Then comes a barren zone, and afterwards come the fresh-water group, the consideration of which we will defer till we have considered

The Upper Limestone Series.

This resembles the Lower Limestone group, except in that it appears to have been deposited nearer to the shore, in shallower and more impure or brackish water.

The limestones are not so thick and not so pure, forming calmy, hydraulic, or cement limestones, and the proportion of sandstones and non-marine beds is greater.

With these qualifications the remarks on the fossils of the Lower Limestone series may equally apply to the above strata, with, however, the remarkable exception of the corals.

The great family of the *Lithostrotions* have entirely disappeared, and of the rugosa which formed whole beds during Lower Limestone times, all have gone with the exception of the very small *Zaphrentis Phillipsi* and *Z. intermedia*, and all the corals that are left (according to the catalogue) are the following species*:—

Chætetes tumida.
Alveolites septosa. (Small, encrusting shells and crinoids.) The large ones, characteristic of the Lower Limestone, have entirely disappeared, and I am doubtful of the identity of the two forms.

* Considerable alterations have been, and are now being, made in the nomenclature of corals, and Mr. Carruthers, who is presently engaged in that work, states that the name *Zaphrentis Phillipsi*, is no longer tenable (see *Geological Magazine*, pp. 20, 68, 158. 1908), and that the coral known in Scotland by this name is not the same as Dr. Vaughan's. As, however, I am writing of the past, it seems to me to be better to retain the old names as I find them.

Palæachis compressa. Var. irregulare.
Zaphrentis Phillipsi.
,, *intermedia.*

The Geological Survey (explanation of sheet 23) gives the following from (locality No. 279) Kennox Water, several miles north of Douglas:—

Amplexus coralloides.
,, sp.
Chaetetes tumidus.
Clisiophyllum, sp.
Cyclophyllum Bowerbanki.
,, *fungites.*
Lithostrotion, sp.

As, however, their list of corals from the rest of the Upper Limestones (in sheets 22, 23, and 31) is only

Chaetetes dubius,
,, *tumidus,*
Zaphrentis Phillipsi,

it seems to me to be more probable that this bed belongs to the Lower Limestone series.

In the Survey Memoir of Central and Western Fife and Kinross-shire, the following are all that are recorded:—

Chaetetes tumidus.
Zaphrentis Phillipsi.
Corals, indet.

In their Memoir on North Arran, &c., sheet 21 (1903), they give

Alveolites depressus.
Lithostrotion Portlocki.
Zaphrentis, sp.

There is only one locality given for *Lithostrotion*, viz., No. 37, a small natural section in Merkland Burn. It is possible that this is in the Lower Limestone series.

The late Dr. Hunter-Selkirk* gives the following corals from the Upper Limestone:—

Alveolites septosa,	rare.
Chaetetes tumidus,	,,
Favosites parasitica,	,,
Palæacis cyclostoma,	,,
,, *compressa*,	,,
Zaphrentis Phillipsi,	common.

The Brachiopod and Lamellibranch fauna will be found fully detailed in our 1901 catalogue, which gives the highest and lowest known localities. Since that catalogue was published the Monomyaria have been revised, and many of the names altered.†

The Middle Coal and Ironstone Group

is situated between the Lower and Upper Limestone groups. It more closely resembles the Upper Carboniferous than either of the above groups, being composed almost entirely of fresh-water strata.

In the East of Scotland this series is known as the Edge Coals, on account of the high angle to which they are tilted up in the Midlothian field, but the description does not apply in the western district.

It contains several workable coals and ironstones, but no limestones, and only one or two thin bands, in which a few marine fossils are found, indicating brackish water conditions, fatal to the majority of marine species. In some of these beds *Lingula squamiformis* is almost the only fossil found. It is very abundant, and grows to about $1\frac{1}{2}$ inches long, being larger there than in any other beds.

The fresh-water fossils consist of Entomostraca (the genus *Carbonia* being abundant), and some half-dozen of Lamellibranchs.

* "The Palæontology of the Carboniferous Strata of the West of Scotland," pt. ii., 1875. Carluke (printed privately).

† "Monograph of the British Carboniferous Lamellibranchiata," by Wheelton Hind, M.D., &c. *Pal. Soc.*, vol. ii. pt. ii., 1903.

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Plants are represented by stems, mostly Lepidodendroid, nearly all in a pyritised condition.

Ganoid fishes are represented by *Rhizodus Hibberti* and a few Palæoniscids.

The Sharks are in strong force, including *Tristichius*, *Ctenacanthus*, *Sphenacanthus*, *Aganacanthus*, and *Gyracanthus*.

Some of these attain to an enormous size. The late Robert Craig collected from the Black Band Ironstone of Dalry teeth of *Rhizodus* 10 inches to 11 inches in length, and spines of *Aganacanthus striatulus* about 14 inches, and spines of *Gyracanthus Youngi* over 2 feet long. So far as we are aware, these are the largest fish remains ever collected in Carboniferous strata anywhere.

Our strata are, however, not to be compared in the number of species with those of the East of Scotland, where whole specimens of ganoid fishes are not uncommon, while very few have ever been found in our strata.

The Millstone Grit Series.

Strictly speaking, the Millstone Grit does not exist here, but certain sandstones, shales, and fireclays, occupying a similar horizon, are regarded as its equivalent.

Some of the lower sandy beds are charged with marine fossils, mostly casts, but as fresh-water conditions slowly supervened, these, in the course of time, gradually die out, the last to disappear being *Lingula* and *Discina*.

Near the junction with the Limestone series there is a remarkable abundance of *Streptorhynchus crenistria*, var. *cylindrica*, which seems confined to about this horizon, as is also *Productus carbonarius*.

A very remarkable discovery was made by the Geological Survey* of a bed containing Lamellibranchs, which, as stated by Dr. Hind, "contain a number of species hitherto unrecorded from Europe, so far as my knowledge goes, but, on the other hand,

* "Summary of Progress," 1905, p. 147.

it exhibits a remarkably close affinity to the Lamellibranch fauna described by Meek from the Coal Measures of Nebraska, Illinois, and other American States. Judging from Meek's descriptions and figures, I am of opinion that a very large number of the Scottish specimens are identical with the American species. . . . The most important feature of this new discovery is the presence in the Scottish collection of the genus *Prothyris* Meek, hitherto known only from North America," &c.

It has been found that a great palæontological break occurs near the middle of this series, which has demonstrated that, as far at least as palæontology is concerned, the Carboniferous formation contains only two divisions, an upper and a lower.

But this need not do away with the old grouping of the rocks into Coal Measures, Millstone Grit, Upper and Lower Limestone, and Calciferous Sandstone series, which are so convenient for stratigraphical and local purposes.

This break is so complete that hardly any plants,* and only two species of fishes† (*Megalichthys Hibberti* and *Acrolepis Hopkinsi*), are common to both Upper and Lower. Yet the marine fauna does not seem to have been affected, as the few returns of marine life above this horizon present us with hardly a single species unknown in the lower horizon.

It is very astonishing that such a tremendous change should take place, destroying practically the whole of the land and fresh-water forms, yet leaving the marine forms unchanged, while not a trace is left in the rocks themselves, neither in change of mineral character, faults, nor unconformities. In fact, although this break has been known for some fifteen or sixteen years, the exact line of demarcation has not yet been found, nor does it seem likely to be found, until two contiguous beds are

* R. Kidston, *Proc. Roy. Phys. Soc. Edin.*, vol. xii., pp. 183-257. 1894.

† Catalogue of 1901, where the species of plants and fishes are given, it being stated whether they are Upper or Lower Carboniferous.

discovered, the one containing Upper and the other Lower Carboniferous fossils.

The Upper Carboniferous.

This is largely developed, and contains the most of our valuable seams of coal, and also ironstones, although these latter are, unfortunately, getting nearly all worked out.

Overlying these are beds of red sandstones and marls, which pass gradually up into the Permian formation, and contain very few fossils.

With certain very rare exceptions, all the above strata represent either land or fresh-water conditions.

The exceptions (which contain only a few marine species) are only sufficient to show that the sea existed somewhere outside our area during the whole of the Upper Carboniferous, as what we have of marine life could hardly be called the open sea.

They are as follows:—

(1) Strata up to the slaty band ironstone and shale, containing *Lingula mytiloides*, *Protoschizodus axiniformis*, *Murchisonia*, and *Nautilus*, all very rare; associated with these truly marine shells is *Anthracoptera modiolaris*.*

The Slaty Band Ironstone is usually considered to be the base of the coal measures.

(2) A thin stratum (about 1 inch) found in a sewer at Alexandra Parade, Glasgow, and containing a small *Goniatite* (common), *Murchisonia*, *Loxonema*, and *Lingula;* while close on it was a bed containing *Carbonicola robusta*, and *aquilina*, *Spirorbis*, and *Pleuroplax*. The position of this bed is not very far above the slaty band ironstone.†

(3) A thin layer lying between the Kiltongue and Virtuewell Coals, discovered by Mr. Robert Dunlop at Calderbank, near Airdrie, containing *Pterinopecten papyraceus*, *Orthoceratites*, and other marine fossils.‡

* *Trans.*, vol. iii., p. 107. † *Trans.*, vol. xi., pp. 147, 149, 315.
‡ *Trans.*, vol. viii., p. 342.

This bed is supposed to be 800 feet below the following:—

(4) A thin bed (discovered by Mr. R. W. Skipsey in 1865, near Drumpark, Coatbridge) containing ironstone nodules, in which are found the following marine fossils:—

Crinoid ossicles.
Discina nitida.
Productus scabriculus.
Protoschizodus (*Axinus*) *axiniformis.*
Conularia quadrisulcata.
Euphemus (*Bellerophon*) *Urei.*

This was the first bed to be discovered, and it was many years before any others were recorded.*

Its position was set down as about 318 feet above the Upper Coal, the highest seam ever worked in the pits.

More recent researches are fully detailed in a paper by John Smith, of Dalry, Ayrshire, and C. T. Clough, M.A., on "The Marine Beds near the base of the Upper Carboniferous red barren measures of Scotland,"† in which it is shown that a bed (probably the same as that discovered by Skipsey) extends over Scotland from Fife and Midlothian to Dalmellington, in Ayrshire, and Kirkconnel, in Dumfriesshire.

The following is the complete list of fossils. There were in all ten localities, and the number opposite each species is the number of localities in which it was found:—

Plant remains (obscure),	2
Crinoid remains,	3
Polyzoan (badly preserved),	1
Chonetes buchiana,	1
„ *Hardrensis,*	2
„ sp. very small,	1
Lingula mytiloides,	3
„ *squamiformis,*	2
„ sp.,	2
Orbiculoidea (*Discina*) *nitida,*	3

* *Trans.*, vol. ii., p. 52, also p. 144.

† "Summary of Progress of the Geological Survey of Great Britain for 1907," p. 127.

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Productus semireticulatus,	2
„ *scabriculus,*	1
„ sp.,	1
Seminula (*Athyris*) *ambigua,*	1
Spirifer, sp.,	1
Lamellibranch, indet.,	1
Sanguinolites,	1
Protoschizodus axiniformis,	1
Posidoniella sulcata,	3
„ *lævis,*	1
„ *vetusta.*	1
„ passage form.	1
• *Pterinopecten papyraceus.*	2
Pecteniform, shell ribbed.	1
Bucania (*Bellerophon*) *decussata,*	1
Euphemus („) *Urei,*	2
Murchisonia (*Aclisina*) *striatula,*	2
Porcellia,	1
Dentalium,	1
Conularia quadrisulcata,	1
Discites rotifer,	1
„ sp. smooth,	1
„ sp. with longitudinal ribs,	1
Nautiloid shell,	1
Dimorphoceras Gilbertsoni,	1
Glyphioceras micronotum,	1
„ indet.	
Goniatites, indet.,	2
Orthoceras attenuatum,	1
„ indet.,	4
Diplodus gibbosus,	1
Mesodomodus, sp. nov.,	1
Petalodus,	1
Rhizodopsis, scales.	
Strepsodus sauroides,	1
Palæoniscid, scales,	1
Cladodus,	1
Fish remains.	2
Centrodus lineatus,	1
Polygnathus mosquensis,	1
Conodonts (several species),	1

The fossils to which attention is chiefly drawn are—

Posidoniella sulcata.
Pterinopectem papyraceus.
Glyphioceras micronotum.
Dimorphoceras Gilbertsoni.

These two latter species were also discovered by Mr. Tait in the Calciferous Sandstone Series of Fifeshire, near Inverkeithing. It is the more surprising that these two species should have survived, seeing they have been always rare in the long series of beds intervening.

Another point worth noting is that the majority of the fishes named are fresh-water fishes, never found in purely marine strata. These are nearly all from Fifeshire, all the other fossils (except plants) being marine.

Fresh-water Strata.

The fossils of the fresh-water strata consist of plants, Crustacea, Lamellibranchs belonging to the *Carbonicola* group, fishes, and reptiles.

The Entomostracea are well represented, and the Schizopods by the genus *Anthrapalæmon*, with at least two species.

The fresh-water mussels, as they are called, viz., the genera *Carbonicola*, *Anthracomya*, and *Naiadites*, are well represented, sometimes forming whole seams (Mussel-band ironstone), some of which are more persistent even than the coals themselves, and form valuable indices of position, although I fear it is the mussel-band rather than the species of which it is composed that is depended upon.

It is very remarkable that Gasteropods have never been found in any of these beds. Dr. Hind has figured a specimen of *Carbonicola robusta* from Shotts, bored with a circular hole, which, but for the above fact, he evidently would have considered the work of a Gasteropod. It, however, wants the conical part which is characteristic of their work.

It is equally remarkable that, although Gasteropods abound in the marine beds, no shells have ever been recorded as having been pierced by them.

Fish remains are found fairly plentiful in some of the beds, but they are mostly scattered and broken up. The beautiful whole fishes which are found outside our area are conspicuous by their absence.

Palæontology.

Our first publication on this subject is an interesting paper entitled "On the Range and Occurrence of Anthracosia and other Shells in the Coal Measures East of Glasgow."* It gives the result of a long series of observations, and is now even more interesting from the fact that the great majority of pits in the district are either worked out or abandoned.

An important paper by the late Dr. Grossart on the "Upper Coal Measures of Lanarkshire"† gives details of the various beds, with their fossil contents. In it he points out that *Sigillaria* and ferns predominate in the upper, while *Calamites* and *Lepidodendrons* predominate in the lower part of the series.

Another paper, written nearly forty years later, gives the "Mineral Seam round Airdrie and other Fossils,"‡ by Robert Dunlop.

Zoning by Means of Fossils.

Extensive investigations with important results have been going on in England and Ireland which bid fair to give us reliable horizons with fossil indices, if, indeed, these have not already been established.

The pioneer of these investigations is Arthur Vaughan, B.A., D.Sc., F.G.S., whose great paper, entitled "The Palæontological Sequence in the Carboniferous Limestone of the Bristol Area" (*Quarterly Journal of the Geological Society*, vol. lxi., p. 181), opened quite a new era in Carboniferous investigation.

He divides the Avon series into six zones, characterised firstly and chiefly by Corals and then by Brachiopods. Extensive investigations have been going on throughout England and Ireland, and these generally confirm Dr. Vaughan's observations.

Unfortunately for us, only the highest of these, the *Dibunophyllum* zone, which I take to be our *Productus giganteus* beds, or at least the lower half of our Lower

* *Trans.*, vol. ii., p. 141. † *Trans.*, vol. iii., p. 96.
‡ *Trans.*, vol. xiii., p. 35.

Limestone series, is represented in our neighbourhood,* the other zones being contemporary with the Calciferous Sandstone series, which with us are barren, although representatives of these zones will probably be found in Fifeshire and Eskdale.

I find his papers somewhat difficult to follow on account of the numerous "mutations" and other sorts of variations to which he refers, so that there is a difficulty in knowing what exactly is meant.

Thus the Corals—

Michelinia,†
Zaphrentis Phillipsi,
Amplexus,
Lithostrotion basaltiformis,

which appear to have died out in the Bristol area before the beginning of our Marine series, are found in our beds, *Zaphrentis Phillipsi* being common from the bottom of our lowest limestones to the top of our Upper Limestone series, being in fact the only cup coral which escaped the general "massacre of the innocents."

Among the Brachiopods—*Cliothyris* (*Athyris*) *Royssii, Reticularia* (*Spirifera*) *lineata, Productus cora, Spiriferina octoplicata,* and *Schizophoria* (*Orthis*) *resupinata,* which seem to have disappeared in Bristol before our day, are found in our strata, the three latter continuing till about Millstone Grit times, as does also *Orthotetes* (*Streptorhynchus*) *crenistria,* while the following species:—

Seminula ambigua,
Productus semireticulatus,
,, *scabriculus,*

which he considers characteristic of his zones, continue with us from the Lower Limestone up to the very top of our Upper Carboniferous strata, so that, although his theories appear to hold good for the thick limestones of

* I desire to emphasise that (unless when otherwise stated) the facts and opinions given in this paper are to be held as strictly confined to the West of Scotland.

† Mr. Carruthers has doubts that true *Michelinia* have been found in Scotland.

England or Ireland, still they can only be of local application, as the species did not disappear till long afterwards.

Several of these species attain their maximum both in numbers and size in the Upper Limestone series, and many other differences could also be noted. Probably, however, it will be found that there are different mutations by which horizons may be identified.

One important point, however, is that Dr. Vaughan considers the various mutations to be descended from previously existing varieties of the same species, and that each succeeding mutation marks a step in evolution, a most valuable principle if it can be properly established, whereas I at least have been apt to consider many of these mutations as due to environment.

Many years ago the Lower Carboniferous series of Belgium was divided into the Lower or Tournaisian and the Upper or Visean series, and Professor de Koninck, the great Belgian authority who visited Glasgow and was entertained by the members of our Society, stated that he considered the Scottish Limestone strata was the equivalent of the Visean of Belgium, a position which seems to be confirmed by Dr. Vaughan's English researches.

His (*i.e.*, Dr. Vaughan's) four lower zones belong to the Tournaisian series, and these appear (to me) to be absent in Scotland.

"The Visean" is tabulated as follows:—

ϵ

Dibunophyllum (D2) (D1) *Lonsdalia floriformis.*

Dibunophyllum. θ

Seminula - (S2) *Productus cora* (Mut. S2).

(S1) *Productus semireticulatus* (Mut.).

δ

Now, in trying to correlate the corals, we labour under the disadvantage that our lists of corals give only, as a rule, a single locality, so that we have no guide to their vertical distribution, and these lists are next to worthless as zoning indices.

It is but fair, however, to Mr. Thomson to state that when this list was made up he was really in a dying condition, the list being defective in names as well as in localities, the additional species being added by Mr. John Smith at the beginning of the re-issue of the volume.

I am inclined to question whether we have the *Seminula* zone at all, but, if we have it, it can only be the top part.

The Dibunophyllum zone seems to me to be represented by our lowest limestones—the Main Limestone group, where the above coral is common, and where also *Productus giganteus* attains its greatest development here, as it does also in England and Ireland.

Dr. Vaughan afterwards marked off another zone over the foregoing, and this he called the *Cyathaxonia* zone. Now, it will be observed that Mr. Thomson's species come from one locality, Cunningham Baidland.* This horizon belongs to what Mr. Craig denominates the "Upper Sub-series of the Lower Limestone," and is divided from the Lower Sub-series of Beith by some 40 feet of divisional shales. It is interesting to notice that Mr. Craig does not record this coral from the Lower Sub-series, but, like Mr. Thomson, only from the upper of Cunningham Baidland. *Cyathaxonia* is not recorded from the Campsie district, nor from Thorntonhall, Kilbride, Carluke, nor Lesmahagow. The evidence, such as it is, therefore, is in favour of Dr. Vaughan's *Cyathaxonia* zone, although that evidence is anything but satisfactory. Dr. Vaughan's type species, *C. Rushiana*, is not, however, known in our beds, and on other grounds I am inclined to doubt whether these beds are the equivalent of Dr. Vaughan's *Cyathaxonia* zone, or whether we have this zone at all.

* In describing some of the types Mr. Thomson also gives as a locality Brockley, in beds on a similar horizon to above.

Palæontology.

I regret that I cannot indicate any Brachiopods which are specially characteristic of this zone.

I very much regret that this is all the help we can get in the meantime from these researches, so that we are left to grope our way alone as best we may.

When we consider the important results which have been obtained from the zoning of fossils, not only in other formations, but also in the Carboniferous formation in England, it is with the greatest regret that we have so little to record here.

Setting aside the rarer forms as of no value for this purpose, there are comparatively few species that can be used for zoning.

It is true that we can recognise several of the beds by their fossil contents, but this is rather by their grouping than by any special species peculiar to that bed.

Among the more prominent species which characterise special beds may be mentioned *Naiadites crassus* and *Lithodomus lithodomoides*, which are common in certain localities at about the Hurlet Limestone horizon, from Beith to the East of Fife. I am not aware of these occurring above that horizon, but in the great majority of localities they are not found at all.

Productus giganteus also flourished enormously about this time, forming whole beds of fossils, known as the *Productus giganteus* limestone. These beds are certainly distinctive of a certain part of our lowest limestone, and can be traced not only over the whole of Scotland, but even as far south as the Bristol area. Yet *Productus giganteus* continued to exist into Upper Limestone times, and is got at Bowertrapping and in the Arden and Orchard Limestones, but very rarely, and as a smooth, dwarfed variety wanting the corrugations.

In the East of Scotland there are several limestones separated by bands of shales, which in the Ayrshire field unite to form one thick limestone (the main limestone). This contains a thin band almost entirely composed of *Lithostrotion junceum*, which appears to cross the country from Ayrshire to the East Lothian and Fifeshire, and

there is a band of *Lithostrotion Portlocki* a short distance above it.

Another remarkable bed is the shale over the Hosie Limestone.* This bed has been recognised by its fossils in Campsie, Thorntonhall (near Busby), Blackburn, Fife, and East Lothian.

One large Entomostracan (*Polycope Youngiana*) is confined to this bed; it is common at Campsie, rather rare at Thorntonhall, and not, so far as I am aware, recorded from any of the other localities.

The characteristic fossils are mostly several species of Goniatites and Orthoceratites, also *Nuculana brevirostris*, *Euomphalus tuberculatus* *Bellerophon Oldhami*, and a small variety of Chonetes (Dav. TT. II. f. 7), and *Pleurotomaria conica*, var. *decussata*, which may possibly be confined to this bed. There is also a variety of *Dimorphoceras Gilbertsoni*, having the *lateral* sinus double, which seems to be confined to this bed.

The following appear to be confined to the Lower Limestones:—

BRACHIOPODA—

Dielasma (*Terebratula*) *sacculus*.
,, *hastata*.
Schizophora (*Orthis*) *Michelini*.
Spirifera duplicicosta.
,, *glabra*.
Athyris plano-sulcata.
,, *Royssii*.
Productus fimbriatus.
,, *Youngianus*.
,, *aculeatus*.
,, *spinulosus*.

LAMELLIBRANCHS—

Edmondia unioniformis.
Sanguinolites variabilis.

MIDDLE IRONSTONE AND COAL SERIES.

This series is characterised by the presence of numbers of fresh-water fishes, some of them very large.

* *Trans.*, vol. i., p. 38, also vol. iv., p. 282.

The great spine of *Gyracanthus Youngi* appears to be confined to this series; it has, however, only been found in the Dalry district and in the Lothians, while *Rhizodus Hibberti*, which makes its first appearance in Calciferous strata, here attains its greatest size, and finally disappears.

The Lamellibranchs are represented by—

*Carbonicola acuta.**
Anthracomya lanceolata.
" *minima.**
*Naiadites carinata.**
magna.
obesa.
quadrata.

Those marked * continue into the Upper Carboniferous.

Upper Limestone Series.

The disappearance of corals from this series is very remarkable, but he would be a bold man who held that these had ceased to exist.

The inference is rather that in our area the conditions were unfavourable, and that corals continued to exist outside of our area wherever favourable conditions prevailed.†

The finding of characteristic fossils is complicated by the Calderwood series of beds, which, on account of their fossil contents, were at one time set down in our catalogue as Upper Limestone, but are now set down by the Survey as belonging to the Lower group.

The evidence in favour of their being of Upper Limestone age is‡—

(1) There is a workable Roman cement containing marine fossils.

(2) The absence from them of all but Upper Limestone forms of corals, while these latter are abundant.

† Mr. J. Smith informs me that large rugose corals are to be found in this series at Cumnock.

‡ *Trans.*, vol. vii., p. 309; vol. x., p. 61.

(3) The presence of certain fossils characteristic of the Upper Limestones, viz.—

Dithyrocaris.
Nautilus nodiferus (*planodorsatus*).
Pterinopectem papyraceus.

Leaving the Kilbride beds, however, out of account, the following may be considered characteristic of the Upper Limestone series:—

Productus latissimus

which is very characteristic of the Index or *Productus latissimus* Limestone. This species is also common in the Lower Limestone beds of Craigen Glen, but there it is a very different variety, having more affinity to *Productus giganteus*. The extremely transverse spindle-shaped variety appears to be confined to about the Index Limestone.

Productus costatus

characteristic especially of the Orchard and Thornliebank shales, where it is common, large, and fine.

The remarkable bed, already alluded to (page 143), occurs under the Arden Limestone, and contains

Edmondia punctatella.
Estheria Youngi,

and probably one or two other species which appear here for the first time, and, after flourishing in millions, disappear within a few inches of their first appearance. This bed, which has been traced for over 28 miles, appears to be the only truly zonal bed of which we can boast.

As we approach the borders of the Millstone Grit, there are several characteristic fossils, *e.g.**

Streptorhynchus crenistria, var. *cylindrica* (*robusta*) is abundant in a band, varying from sandstone, sandy limestone, to sandy shale, which has been traced from Campbeltown through Muirkirk to several miles north-east of Glasgow, and appears to be a continuous, well-marked

* *Trans.*, vol. ii., p. 76; vol. v., p. 222.

band. It appears to be confined to the horizon bordering the Millstone Grit.

The Roman Cement* Shales, situated about the dividing line with the Millstone Grit series contain several characteristic shells.

A bed almost composed of large variety of *Myalina Verneuili.*

Productus carbonarius de Kon., not uncommon at Garngad Road, its only British locality. It occurs in a similar horizon in Belgium.

Productus sinuatus.
Nuculana Sharmani.
Nautilus nodiferus (*dorsocarinatus*).

Omitting isolated individuals, the following appear to be confined to the Upper Limestone division:—

BRACHIOPODA—

Spiriferina insculpta.
Streptorhynchus crenistria var. (*robusta*) *cylindrica.*
Strophomena rhomboidalis var. distorta.

LAMELLIBRANCHIATA—

Protoschizodus axiniformis.
Sanguinolites plicatus.
Nuculana Sharmani.
" *stilla.*

CEPHALOPODA—

Nautilus nodiferus (*dorsocarinatus*).

Regarding the bed with Nebraskan fossils, referred to on page 150, I have just received from the author the following paper, which has just been published, "On the Lamellibranch and Gasteropod Fauna found in the Millstone Grit of Scotland," by Wheelton Hind, M.D., B.S., F.R.C.S., F.G.S.,† in which he gives descriptions of the beds, with their remarkable fossil contents. The position of these beds he considers to be in that part of the

* All our workable cements are known as Roman Cements. The others, however, have local names, as Orchard, Calderside.

† *Trans. Royal Soc., Edinburgh*, vol. xlvi. pt. ii., p. 331. 1908.

Millstone Grit series which is not far below the line which has been drawn between the Upper and Lower Carboniferous floras, in accordance with Dr. Kidston's determinations, and has been traced in the counties of Midlothian, Linlithgow, Lanark, and Stirling, so that we must regard it as a distinctly zonal horizon. There are in all six localities given, of which only two come into our district, viz., Greenfoot Quarry, on the farm of Gain, near Glenboig Station; and fireclay works, a little N. of E. of Castlecary Station (during sinking operations), but specimens may be expected and should be looked for in the moulding sand quarries at Garngad Road.

In all, twenty-six species are recorded from Scotland, of which eleven are also found in Nebraska, but there is only one species common to Nebraska, Scotland, and England, while of those found in Scotland eleven species are American and five are new.

Besides Lamellibranchs, seven species of Gasteropods have been recorded, and there are, besides, shells belonging to (or resembling) *Orthoceras*, *Goniatites*, and *Lingula*.

While from beds on pretty nearly the same horizon at Garngad Road there have been found *Edmondia*, *Lingula mytiloides*, and *Discina*, the last two being abundant. One slab was found containing about four hundred shells of *Discina*.

Upper Carboniferous.

The exact position of the dividing line between the Upper and Lower Carboniferous has not yet been definitely traced, but it is probably some distance below the Slaty Band Ironstone, which was the old dividing line between the Coal Measures and the Millstone Grit.

Brachiopods are generally, yet sparsely, distributed up to the Slaty Band Ironstone, above which the only known marine bands are those already noted (page 151).

The Lamellibranchs consist of the three genera *Carbonicola*, *Anthracomya*, and *Naiadites*, of which *Carbonicola aquilina* and *Carbonicola robusta* are

characteristic of the lower beds, *C. robusta* occurring up to the Drumgray Coal, above which it disappears.

The other species are characteristic of the higher beds, their first appearance dating from about the disappearance of *C. robusta*. *Naiadites quadratus* appear to be confined to the neighbourhood of the splint coal.

Fishes.—There is a remarkable band of these in the roof of the splint coal, which contains, among other things, *Gyracanthus formosus* and *Sphenacanthus hybodoides*. These seem to make their first appearance in this bed, and continue to the top of the series.

Reptiles.—Although several discoveries of reptilian remains have been reported from about the Hurlet Limestone horizon, yet it is doubtful whether these existed before Upper Carboniferous time. The finest specimens have been got in the Airdrie Blackband Ironstone at Quarter. They are also got above the splint coal, and in the Palacecraig Ironstone, the highest workable seam in the district.

The uppermost marine band (see page 152) appears to be persistent over the whole district, and possesses distinct zonal value.

The highest positions in which fossils have been found in our district are—

About 230 fathoms above the Ell Coal, the highest workable seam.

This was discovered by Mr. John Smith at Barony Pit, 1¼ miles west of Auchinleck, Ayrshire. It occurs in the Barren (?) Upper Red Sandstone group, and from the fossils (all plants) Mr. Kidston considers that "the rocks from which the plants were collected belong without doubt to the Radstockian series, though probably to its lower portion. These red beds at the Barony Pit I regard as on the same horizon as the Keele group of North Staffordshire and the beds at Jockies Sike, Cumberland."* The following species have not been recorded in

* *Trans.*, vol. xiii., p. 224. This discovery is also detailed in the "Summary of Progress of the Geological Survey of Great Britain for 1907," p. 111.

previous catalogues, and may be considered as peculiarly characteristic of this "Barren (?) Upper Red division":—

Lepidodendron intermedium.
" *dichotomum.*
Lepidodostrobus arenosus.
Calamocladus charœformis.
Annularia stellata.
Dactylotheca plumosa.
Neuropteris impar.
" *Scheuchzeri.*
" *flexuoso.*
" *rarinervis.*
" *ovata.*
Pecopteris Miltoni.
" *cyathea.*

What is probably this same bed was discovered by the late Mr. John Howat, about forty years ago at Ochiltree. It contained several species of plant remains, including *Pecopteris cyathea*, in a creamy white shale exactly as described by Mr. Smith.

About 30 fathoms above this is a thin band of *Spirorbis* Limestone, which has been traced over a large area.

This was originally discovered by Mr. Binnie, of Manchester, and considered by him to be on the horizon of the *Spirorbis* Limestone of the Manchester coalfield.

In conclusion, I have to say that the latter part of this paper—that referring to zoning—has caused me considerable difficulty. The conclusions have only been arrived at with hesitation and by rigidly excluding rare species, and even common species from strata where they are rare, unless they recur in lower and higher strata. The utmost that I expect is that this will form a beginning or foundation from which more correct views may be evolved.

The Secondary Rocks.

The principal contribution to this subject from our Society is that contained in the "Catalogue of Western Scottish Fossils, 1876," on "The Jurassic Strata of Skye and Raasay," in which the history of discovery is traced,

and a succinct account of the various beds, with their prominent characteristics, is given by Dr. James Bryce, LL.D., followed by a list of the fossils of Skye, Raasay, and Mull, prepared by Mr. James Armstrong.

This is followed by an account of the "Tertiary Formation in Western Scotland," with a list of the Ardtun fossils.

Dr. Bryce, who was one of the pioneers in this department, published the result of his papers in the *Quarterly Journal* under the heading of "On the Jurassic Rocks of Skye and Raasay," by James Bryce, LL.D., &c., with a palæontological appendix by Ralph Tate, Esq., F.G.S. (*Q.J.G.S.*, 1873, p. 317), yet the preliminary papers from which this was compiled were read to our Society, and Dr. Bryce presented us with the collection of fossils from these districts, and these are now in the Kelvingrove Museum.*

SECONDARY.

Until lately it was not known that fossiliferous secondary rocks existed within the Clyde drainage area, and those outside that area were so far away that it was very difficult for our members, with their restricted holidays, to do any original work among them. It was as much as most could do to see and become acquainted with what had already been done by others.

The papers in our *Transactions* are mostly such records, and their principal value is that they focus the information and act as guides for those who visit these districts.

The principal of these papers are as follows:—"A Collection of Liassic Fossils from Skye, including some fifteen species not previously recorded," by Rev. H. W. Crosskey (*Transactions*, vol. ii., p. 16); "Notes on Mull and its Leaf Beds,"† by W. E. Koch, B.A., &c. (*Transac-*

* Dr. Bryce will probably be best remembered by his book on the geology of Arran and other Clyde Islands, which went through four editions. An account of the flora of the islands appended to that work was drawn up by the author's eldest son, Mr. James Bryce, the present British Ambassador to the United States, Washington.

† The fossils from these beds have been described by Mr. J. Starkie Gardner, F.G.S. *Q.J.G.S.*, vol. xliii., p. 270. 1877.

tions, vol. vii., p. 52); "The Leaf Caves of Mull," by John Dougal, M.D. (*Transactions*, vol. ix., p. 286); "Notes on the Geology of the Island of Eigg," by Henry Taylor (*Transactions*, vol. xi., p. 32). (Mr. Taylor has for some years been located in the Transvaal.)

For fuller information the reader is referred to Professor Judd's three important papers on "The Secondary Rocks of Scotland," the first of which deals with "The Strata of the North-East Coast of Scotland" (*Q.J.G.S.*, 1873, p. 98). The second deals with "The Ancient Volcanoes of the Highlands," with the relations of their products to the Mesozoic Strata (*Q.J.G.S.*, 1874, p. 220). The third paper deals with "The Strata of the Western Coasts and Islands" (*Q.J.G.S.*, 1878, p. 660). These two latter papers, which are illustrated by coloured maps and sections, are indispensable to those who would seek to understand the strata of these interesting districts.

The third paper, which gives a table of the strata, showing each series with their characteristic fossils and their principal localities and equivalent strata outside of Scotland, shows that the following beds have been identified by their fossil contents:—

Tertiary, Miocene.

Cretaceous { Chalk. / Greensand.

GREAT UNCONFORMABLE BREAK.

Jurassic {
Middle and Lower Oxford.
Great Oolite.
Lower Oolite.
Upper Lias.
Middle Lias.
Lower Lias.
Infra Lias.

Trias and Permian, Poikilitic.
Palæozoic, Carboniferous.

Palæontology.

ARRAN.

About the year 1899 the late Mr. Wm. Gunn, of the Geological Survey, discovered to the south of the String Road, Arran, a great volcanic vent of Tertiary age. It is of oval form, and between three and four miles in length. Scattered through this vent are numerous fragments of different kinds, apparently broken off from their parent rocks and scattered about, forming a sort of patchwork of islands in this volcanic sea. This fragmental area has been traced over a distance of two and a half miles in length by two and a quarter miles in breadth, and probably quite one-half of this area is occupied by these fragmental rocks, which appear to be part of the strata which covered this spot before the volcanic eruption had blown the whole away, and these rocks would appear to have fallen or slid back into the old crater.

Many of the fragments have been identified as belonging to the Triassic, Rhætic, Liassic, and Cretaceous formations, thus showing that this vent was post-Cretaceous; while the fact that several of the fragments are traversed by Tertiary dikes or sills shows it to have been anterior to that part of the Tertiary formation, and limits its date to late Cretaceous or early Tertiary times, probably the latter, as we know of no great volcanic disturbance during late Cretaceous times.

The largest of these fragments was found about a quarter of a mile north-east of the farm of Derenenach, about one mile south of the junction of the roads leading to Machrie Bay and to Blackwaterfoot.

RHŒTIC FOSSILS.

These fossils were found in two small burns. The more northerly, called Allt an Dris, is the only one marked on the one-inch map. This fragment was probably quite a quarter of a mile long from north to south, while its

greatest width would be about 150 yards. About 90 yards are exposed in the burn, and found to consist mostly of red Triassic marls with grey marls in a less degree, along with Rhætic rocks. The sequence is somewhat doubtful, but is probably as follows:—

Black shales and thin grey limestones of Rhætic age.

Greenish-grey or pale-coloured, compact marls. Upper Keuper.

Red Marls. Keuper.

In 1900 Mr. Gunn returned, accompanied by Mr. Macconachie, who was successful in obtaining organic remains of Rhætic age, of which seven species have been identified.

The best fossils have been found on the north-east bank of the burn, at some distance above its junction with a small stream which goes off to the left. There is here a small rocky gorge about 90 yards long, and it is in this gorge, below the point where the burn takes a sharp turn to the left, that the fossils are found.

Lias Fossils.

Lias fossils have been also found in a patch in the agglomerate of brownish crumbling calcareous shale and impure decomposed limestone, about one mile south-east of the Rhætic locality. It occurs some 300 yards north of a fork in the Ballymichael burn, near the head of the glen, in a dry gully on the north-west side of the stream, and about one and a half miles E.N.E. of Ballymichael.

The patch is probably about 100 yards long and nearly 50 yards wide. The fossils, which are in some parts abundant, are mostly in the form of casts. In all, about thirty species have been recorded, showing that these beds belong to the *Ammonites angulatus* zone of the Lower Lias.

Cretaceous.

No trace of any kind of rocks between the Lower Lias and the Cretaceous having been found in Arran, it has

been concluded that in all probability the Cretaceous rocks rested immediately on the Liassic rocks, as they do in the North of Ireland.

Cretaceous fossils have been found in two localities in Arran, one of these being in Ballymichael Glen, about 200 yards below the place where the Lias fossils were found, and a few yards above a fork where a small stream comes in from the east.

The fossils were found in detached masses of hard, light-coloured limestone, resembling the chalk limestone of the North of Ireland, containing irregular masses of chert or flint, which were almost pure white.

Eight species of fossils are recorded from this locality. Several other localities are given in which rocks resembling the above were noted, but at only one of these, the "Pigeon Cave," on Ard Bheinn, and 1100 yards N.E. from Derenenach, has anything been recognised, and we are told that "some specimens of the limestone taken from this cave contain Cretaceous foraminifera." The limestone in the other localities having been altered by igneous action into crystalline marble, there is very little hope of fossils being found in them.

We have here a most wonderful chapter opened to us through the instrumentality of fossils, as, but for these, it might never have been dreamed that these strata existed in the Clyde area, and although the rocks themselves had been ever so minutely described, no evidence of their age could have been given, and even at the present time no evidence of this kind is known to exist, other than the fossil evidence.*

An interesting paper on this subject, entitled "A Tertiary Volcanic Vent in the Island of Arran," by James Stark, *V.-P.*, will be found in our *Transactions*, vol. xiii., p. 196.

* See the Geology of North Arran, South Bute, and the Cumbraes, &c., by the Geological Survey, 1903.

Chapter VIII.

REVIEW OF FIFTY YEARS' WORK—
Continued.

Glacial Geology.

JAMES SMITH of Jordanhill was President of the Society from 1851 till 1867, and, although none of his papers were published in its *Transactions*, he was one of the pioneers in glacial geology and the first person to determine the northern origin of certain marine fossils found in the Clyde beds. His collected papers were published in a volume entitled "Researches in Newer Pliocene and Post-tertiary Geology."

1860. JOHN YOUNG.—Mr. Young, in his paper, "Geology of Campsie," notes the occurrence of boulders on the low ground and hillsides, which are mostly traps from the west part of the Campsie range, with some Old Red Sandstones, metamorphosed Silurian schist, and quartzose rocks from the Grampians to the N.W., also a few small boulders of granite. Thinks the boulders have been carried by floating ice. Takes notice of the boulder clay in the valley, and the sands and gravels above it (vol. i., p. 13).

Gives a list of over two hundred varieties of boulders from the boulder clay of Gilmorehill, site of new University (vol. iii., p. 298).*

Gives his opinion as to the origin of certain erratics in the till of Glasgow (vol. iv., p. 259).

1864. ARCHIBALD GEIKIE, in a lecture to the Society on the origin of the present scenery of Scotland, refers to the "grand march of the old ice sheet and traces left by it" (vol. ii., p. 4).

Part 2, vol. iii., of the *Transactions* is devoted to a

* Specimens in University Museum.

paper by Mr. Geikie "On the Phenomena of the Glacial Drift of Scotland," where he gives an account of all that was known about the drift and a list of fossils (vol. iii., p. 1).

1865. HENRY W. CROSSKEY gives James Smith credit for having established the "glacial beds" as a distinct series, and describes sections at Lochgilphead, Kyles of Bute, and Paisley, pointing out the striking differences between the boulder clay, laminated clay, and the shell beds. Considers the boulder clay to be unfossiliferous (vol. ii., p. 45).

Compares the glacial deposits of Scotland with those of Canada, and states that the clays on the E. coast of Scotland contain shells more Arctic in character than those of the W. coast (vol. ii., p. 132).

1865. JOHN D. CAMPBELL thought the facts were in favour of boulder clay having been deposited by land ice, but did not wish to express himself too confidently on this point (vol. ii., p. 54).

1867 to 1873. CROSSKEY and ROBERTSON give descriptions of a large number of localities where the Clyde glacial beds crop out, extending from Loch Fyne to Campbeltown, and near Girvan, and inland to Paisley. Note the occurrence of foraminifera in the laminated clay, which occurs between the boulder clay and shell beds. A special feature of their joint papers is the lists of fossils, which are of great use to students (vol. ii., 267; vol. iii., p. 113; vol. iii., p. 321; vol. iv., p. 32; vol. iv., p. 128; vol. iv., p. 241; vol. v., p. 29).

1868 to 1894. JAMES BENNIE, in his paper on the "Surface Geology around Glasgow," gives journals of bores, shows that the drift is at one part 360 feet deep, this section extending to 230 feet below sea-level (vol. iii., p. 133).

In his paper on the "Ancient Lake of Cowden Glen" gives lists of insects, crustacea, and plants from stratified beds between boulder clays. Notes the occurrence of *Papaver somniferum* (vol. ix., p. 213.)

Gives a list of plants from a peat bed in boulder clay at Faskine (vol. x., p. 198).

1869. Craig and Young.—"Kilmaurs Mammoth Bed." —Mammoth remains were discovered in the Woodhill Quarry near Kilmaurs in 1816. Authors give a history of the discovery, and show that there is a glacial shell bed under thick boulder clay, and that the mammoth and reindeer remains occur *under* the shell bed. From plant seeds, *Potomageton*, &c., got in the hollow of a mammoth's tusk, it would appear that the elephants had been swamped in a small lake which, on the land sinking, had got covered by marine deposits, which in their turn were overlain by thick boulder clay (vol. iii., p. 310).

1869. John Burns, in a paper on the "Post-tertiary Deposits of the Carse of Falkirk," gives a list of fossils (vol. iii., p. 367).

1869 to 1897. Robert Craig, in a paper on the "Cowden Glen Section," makes remarks on the upper boulder clay (vol. iv., p. 17).

In a paper on the "Beith Branch Railway" gives percentages of boulders from eight localities, and shows that a number of the blocks came from the West Highlands (vol. iv., p. 45).

Notes the occurrence of mammoth remains in stratified beds under 76 feet of boulder clay at Drummuir, and supports Dr. Bryce's surmise that this bed may be the equivalent of the Cromer Forest bed (vol. viii., p. 213).

Gives a history of the "Kilmaurs Mammoth Bed," and says, "I am now convinced that the bed containing the mammoth and reindeer remains lies at the base of the glacial deposits and below the lower boulder clay" (vol. xii., p. 192).

1872 to 1893. Dugald Bell has contributed several papers on "Glacial Geology," and appears to rely entirely on the direction of striæ and position of boulders for his interpretations of glacial phenomena.

Supports Hopkins' theory that the Clyde large felspar

granite blocks came from Loch Garabal district, and not from Ben Cruachan, as was generally supposed.

Where shells occur in the drift beds, he considers them to have been carried up by land ice (vol. iv., p. 63; vol. iv., p. 300; vol. v., p. 234; vol. vii., p. 172; vol. viii., p. 254; vol. ix., p. 100; vol. ix., p. 321; vol. ix., p. 345; vol. x., p. 16; vol. x., p. 105).

1872. William Fraser.—"Paisley Clay Beds and their relation to the Glacial Period" (vol. iv., p. 178).

1873. James Geikie contributed a paper on "Erratics at Higher Levels than the Rocks from which they had been Derived," and thought they had been taken up by land ice (vol. iv., p. 235).

1874. R. L. Jack gives details of "Till or Boulder Clay in Endrick Valley" up to 320 feet with broken shells, and considers that the shells and clay had been carried up by land ice (vol. v., p. 5).

1876 to 1881. David Robertson.—Papers on "Glacial Beds at Arkleston, Misk, Garnock Water, Gas Tank, Paisley, and Garval Park, Greenock," with lists of fossils (vol. v., p. 281; vol. v., p. 292; vol. vi., p. 53; vol. vii., p. 1).

1881. Thomas Stewart contributed a paper on part of the "Mainland of Shetland," and says that the lower boulder clay is of the same nature as the rock on which it rests, and the upper contains boulders and stones which lay in the track of the ice sheet (vol. vii., p. 66).

1883. David Forsyth.—A list of fossils from clay taken from Girvan Harbour includes *Tellina calcarea* and Pecten Islandicus (vol. vii., p. 251).

1883. John Horne—"Geology of the Isle of Man"—takes notice of the glacial deposits in the north "evidently of marine origin," and thinks some boulders have been carried to 800 feet above their source. Notes boulders from Criffel granite and other places (vol. vii., p. 279).

1883. Thomas Scott and James Steel record the occurrence of *Leda arctica* and *Lyonsia arenosa* in the

Post-pliocene clays of Garval Park; give a list of eight Arctic species of shells and a general list (vol. vii., p. 279).

1885. William Jolly—" Parallel Roads of Lochaber" —adopts the theory of Agassiz put forward in 1842, that the "roads" were formed by lakes dammed by glacier ice. Gives a summary of the principal publications on the subject (vol. viii., p. 40).

Conducted an excursion of members who visited Lochaber in 1885 (vol. viii., p. 72).

1887 to 1894. James Anderson—"Glaciation and Raised Beaches in Jura and Islay"—notes the intensely polished surfaces of rock, especially in the bottoms and on sides of the main valleys.

Raised beaches occur all round the islands, the lower one often without herbage.

Glen Asdale contains a bank of loose material 50 feet high of earth and angular stones brought together by a recent glacier (vol. viii., p. 316).

Paper on "The Most recent Glaciers of the Firth of Clyde," with map showing the extent to which the glaciers filled the glens (vol. x., p. 198).

1888. Thomas Scott.—" On a Shelly Clay at Greenock," 62 feet above sea-level, with *Tellina calcarea*, &c. (vol. viii., p. 267).

1888. Robert Dunlop.—On a bed of peat in clay, which may be boulder clay, with a list of insects and plant seeds from it (vol. viii., p. 312).

1889. Matthew Blair—" Surface Geology of Paisley" —gives percentages of boulders in the clay—Clayslate and greywacke, 7 per cent.; granite, 10 per cent.; details of sections, and traces the limit of the sea during recent times to 73½ feet (vol. ix., p. 139).

1890 to 1901. John Smith—" Great Ice Age in the Garnock Valley"—gives section of drift, positions and sizes of boulders, many of them West Highland blocks and Loch Garabal granite (given as Cruachan) as far south as Dalry and Kilwinning; Glen Falloch diorite at Dalry;

Fereneze porphyry at Kilwinning (4 plates, vol. ix., p. 151).

1892. "Doon to Girvan Water."—Notes the occurrence of Loch Doon granite and Highland schists near the Heads of Ayr (1 plate, vol. x., p. 1).

1893. "Geological Position of the Irvine Whale Bed." —Gives a list of shells, and compares them with those from the earlier glacial beds and the present sea beach (1 plate, vol. x., p. 29).

1895. "New View of the Arran Granite Mountains."—Notices the immense quantities of granite blocks in some of the glens, and their occurrence on the "slate" area north of the granite; also the sandy nature of the drift (vol. x., p. 216).

1895. "Dry River Channels near Muirkirk."—Considers them to have been cut during the later part of the glacial epoch, and they are formed both in rock and drift. When the Ponesk cut through the felspar ridge the valley to the north was probably filled with ice (1 plate, vol. x., p. 331).

1897. "Drift or Glacial Deposits of Ayrshire."—Published as a supplement to vol. xi.

When I began my investigation into the glacial geology of Ayrshire I (like most of our members of that time) held strongly to the opinion that boulder clay was a product of land ice—a so-called "ground moraine"—a structureless mass of clay, stones, and boulders, but I had to abandon this notion, and now believe the various beds of it, four in some sections, to be marine deposits with well-preserved fossils, often crowded with foraminifera. When boulder clay is being dug it looks in most cases like a massive deposit, but after being weathered—if it does not slip—it is often seen to be well stratified; lumps of it thrown on spoil heaps can sometimes be split up like shale from the laminæ being interbanded with sand, and boulders are seen to have squeezed down the laminæ from having been dropped from floating ice upon it. Long boulders sometimes occur standing right

on end, both in the clay and the interbedded sand and gravel deposits.

The shells, although often broken, are generally in an exquisite state of preservation; occasionally they are striated where ice has ploughed in amongst the clay.

Some people are of opinion that the shells have been carried up by birds, but the bulk of them have lived in *twenty or more fathoms of water, were covered up where they lived*, and certainly never were *rubbed* for a single tide on a seashore. When rubbed shore shells are got in boulder clay, which is very seldom, they have probably been dropped from bits of floating shore ice.

In the sand and gravel beds interbanded in the boulder clays shells are seldom seen, the bulk of them having evidently been dissolved away by the passage of acidulated water through these loose materials.

A special feature of the boulder drift is the laminated clay deposits, which often occur interbedded in them. Sometimes the beds are found to be twisted and deformed, but often they occur quite undisturbed. These beds sometimes contain stones, and I have seen blocks up to 5 feet in diameter in them, these facts, of course, showing that they are just strongly-bedded boulder clays.

The drift fossils occur in Ayrshire from below sea-level to 1330 feet above it; higher than that I have found no material capable of having preserved fossils. These fossils may be collected from a great number of sections, some of them containing two hundred specimens to the cubic yard of clay.

In the Irvine and Ayr Valleys there are long stretches of drift, often occupying delta-like areas, but as we recede from this favoured and tranquil area the drifts of the Southern Uplands and the Western Highlands are seldom composed of material fine enough to have preserved fossils,* and the quantities

* Eight to ten feet of the upper part of the boulder-clay has been so rotted that blocks of granite, etc., have been reduced to sand and clay; and as this part would probably be formed in deep water, we have now no means of knowing what kind of fossils it may have contained.

of ice in various forms would be unfavourable for mollusca, &c., invading these regions, but for all that a lot remains to be done in them; for instance, in the Southern Uplands, at a point about halfway between the two seas, I found a patch of boulder clay which contains a lot of marine foraminifera.

The key to the Lochaber district and its "parallel roads" lies in the little Guelt Valley in Ayrshire, and I submit the following comparative sections:—

Spean at 855 feet.	Guelt at 860 feet.
1. Boulder sand and gravel.	1. Boulder clay.
2. Sand and gravel.	2. Sand.
3. Boulder mud.	3. Boulder clay.
4. Sand, with laminæ of clay.	4. Sand, both sharp and muddy.
5. (Not exposed).	5. Boulder clay.
Rock (on opposite side of Spean).	Rock.

The upper boulder bed on the Spean is 32 feet thick, that of the Guelt 37 feet. The other beds of the sections differ considerably in thickness, but that is a feature incidental to all strata. The only term wanting to complete the similarity of the two sections is No. 5 Spean, but there may be a boulder bed here, as drift sections often—but not always—begin with a boulder bed. The three boulder beds of the Guelt all contain *marine fossils*, but I found none in any part of the Spean section—the materials are too sandy to have preserved them—however, No. 3 bed might be examined for foraminifera.

It is owing to the sandy nature of the deposits in Lochaber that there are "roads"; *rain sinks into them* instead of deforming them; and the surface of the Spean section is part of one of the "roads"—just an old sea beach where previous deposits were levelled a bit during the rise of the land.

The geological surveyors consider that the mammoth bed at Kilmaurs is an interglacial deposit, but there is one term in the evidence wanting before that can be established as a fact—no striæ have been recorded as occurring on the rock under the mammoth bed; however, a thin peaty deposit with fresh-water plants and elephant

bones, overlain by a thin bed with Arctic shells, demolishes the theory that the great bed of boulder clay above it was a product of land ice. Logically, of course, the mammoth bed must be an interglacial deposit, and the great thickness of land ice that subsisted during the coldest part of the glacial epoch had melted away in the low ground before the mammoths obtained a footing at Kilmaurs.

I would like to point out that in the boulder clay beds the intensely Arctic species of shells are often "conspicuous by their absence," and the "Clyde beds" contain shells of a more Arctic character than many parts of the boulder clays. The best preserved shells in the boulder clay are the delicate little *Ledas*, sometimes with the valves united, and the strong *Astartes*. *Melobisea* is sometimes got sticking to striated boulders; and on Carlton Hill I found perforations made by the boring shell *Saxicava* in limestone rock at from 300 to 450 feet above sea-level.*

Loch Doon was lowered some 13 feet by having a mine cut through the rock at head of Glen Ness, and the rock exposed by this operation is seen to be strongly ice marked, so that the hollow in which the loch lies was very likely cut out by glacier ice, every scratch representing so much rock carried away.

The recent moraines of Loch Doon contain rounded blocks of granite and angular ones of greywacke.

1900. "Boulder Clay, Hamilton Hill."—In this communication I have shown that the clay of this deposit has mostly been derived from Highland rocks, the stones and boulders being mostly local, and concluded that it had been "laid down in sea water which was kept constantly charged with mud carried by streams flowing from underneath Highland glaciers and from the melting of floating ice" vol. xii., p. 65).

1901. "Geology of Elvanfoot to Wanlockhead Railway."—In this paper I give descriptions of the

* *Geological Magazine*, November, 1903.

sections from 889 feet to 1520 feet above sea-level, showing that *the drift is all stratified* with very little clay, but with granite boulders from the Loch Doon (Forest of Starr) district. No striæ were seen on the rocks in the railway sections under the drift (vol. xii., p. 81).

1892. W. J. MILLAR—"Bowling Reservoir"—gives a list of boulders, including mica schist, chlorite schist, and granite (vol. x., p. 1).

1893. JOHN RENWICK—"Excursion to Glen Fruin"—describes the full extent of the "Bell-Renwick Moraine" (vol. x., p. 96).

1894. JOSEPH WRIGHT—"Boulder Clay a Marine Deposit"—gives lists of twenty species of foraminifera from six localities near Glasgow, and a second list of twenty-five species from ten localities near Glasgow (vol. x., pp. 263, 272).

1894. JAMES NEILSON—"Marine Organisms in the Boulder Clay of the Glasgow District"—gives descriptions of localities and comments on the finding of foraminifera by Mr. Joseph Wright (vol. x., pp. 273, 278).

1890. JOHN BALLANTYNE gives sections and list of fossils from cutting at "Gaswork, Rothesay" (vol. xi., p. 280).

1899. MATTHEW BLAIR.—"Moraines and Deltas."—Abstract supports author's view as to the "Delta-like Drift Deposits" (vol. xi., p. 289).

1899. CHARLES R. COWIE.—"Glacial Phenomena, Loch Ranza." (vol. xi., p. 282).

1900. COLIN LIVINGSTON.—"Descriptions of Detrital Lines, Rock Striations, and Boulders" in Lochaber (vol. xii., p. 39).

1905. "Parallel Roads of Lochaber."—Ice Margin Theory.— Supposes the "roads" to have been formed by washings from the hillsides, which were stopped by ice filling the glens up to the heights at which the various roads occur, and in this way made the feature of the "roads" (vol. xii., p. 326).

1899. James Stark—" Surface Geology, Falls of Clyde District "—shows how the Clyde and Moose have left their ancient valleys and cut largely into rock (vol. xii., p. 52, map).

1906. J. W. Gregory.—Professor Gregory describes a glaciated rock surface at Lugton, and thinks there is proof of an ascending ice movement. Discusses the age of the Lochwinnoch and Loch Libo gaps (2 plates, vol. xiii., p. 10).

1907. J. Renwick and J. W. Gregory—" Loch Lomond Moraines "—Revise history of Glen Fruin Moraine, and give additional matter. Contrast the intra- and extra-morainic areas. Give localities for other corresponding moraines on hillsides near Loch Lomond, also at Buchlyvie, which they think may have been formed about the same time as the Glen Fruin Moraine (vol. xiii., p. 45).

Chapter IX.

Biographical Notices.

JOHN YOUNG, LL.D., F.G.S.

IN the year 1860 the Society published its first *Transactions*, which contained the paper which had been read by Mr. John Young upon the "Geology of Campsie." John Young was a native of Campsie parish, where he was born in July, 1823, having at the time of his death reached his seventy-seventh year. His father, Thomas Young, was foreman joiner in the Lennoxmill Printworks of Dalglish, Falconer & Co., then one of the most important industrial concerns of the district. His grandfather also lived in the parish, and his great-grandfather was tenant of Muirhead farm, on the Campsie estate, so that he was not only by birth but by descent identified with the district he loved so well, and the geology of which he did so much to elucidate.

When quite a lad his attention was drawn to the fossiliferous beds in and about Campsie, and he soon began to form the nucleus of his afterwards famous collection, and to study the general geology of the neighbourhood. Having been brought up to the trade of a blockcutter in the works of the firm already mentioned, an industry which afterwards became extinct, as the wooden printing blocks by which the patterns were impressed on the fabrics were generally superseded by copper roller and cylinder printing by machinery, his days were fully occupied, and only on holidays and odd afternoons did he find time to follow his favourite pursuit.

But, in spite of all such obstacles, he worked at the local geology to such purpose that in the year 1851 or thereby he became a recognised authority on it, and acted

as guide to the Glasgow geologists of the day—many of them members of the Natural History Society—on excursions which they took to the Campsie district.

In 1855, when the meeting of the British Association was held in Glasgow, John Young was chosen to arrange the local collections of rocks and fossils got up for the occasion, being selected for the work more than probably through the influence of William Gourlie, a well-known Glasgow geologist, who was the principal local secretary for the meeting, and of whom it was afterwards said that his exertion to make it a success shortened his life.

On 30th April, 1858, this Society was founded. Amongst the members who were present were Thomas M. Barr, C.E.; James Thomson, F.G.S.; and Mr. James Horne, who was the first Secretary, and who afterwards went to London. On 14th April, 1859, the minutes bear that Mr. John Young, of Campsie, with Dr. Scouler and Dr. James Bryce, was elected an Honorary Associate, being the first elected by the Society.

In the Society's first year—1858—a number of excursions were organised to the Campsie district. These were under the leadership of John Young, whose thorough acquaintance with the subject is minuted. On 2nd December of the same year Mr. Young delivered his lecture on "The Geology of the Campsie District." This was probably his first paper to the Society.

In 1859 the post of assistant keeper of the Hunterian Museum, then located in a building to the rear of the old Glasgow College in High Street, became vacant, and, through the influence to some extent of the members of this Society and the Glasgow Natural History Society, who had become aware of his fitness for the position, and also through the influence of Lord Kelvin, Mr. Young obtained the appointment.

The salary attached to the post of assistant keeper in the Hunterian Museum was £40 and a free house. Doubtless in a pecuniary sense he lost heavily by the translation from the Campsie Printworks to the museum, but science

John Young, LL.D., F.G.S.

gained vastly, and then for the first time there came to him comparative leisure, opportunities for study, the use of books and classes, and to the full John Young availed himself of the chance, and became the ardent student we knew him. We feel safe in saying that from the time he came to reside in Glasgow till he was forced to leave it he never ceased to acquire geological knowledge.

In 1874 Mr. Young was appointed Lecturer in Geology in the Mechanics' Institution, succeeding a series of distinguished teachers—Dr. Taylor, Mr. Struthers, Dr. Crosskey, Dr. Page, and Dr. Robert Brown—and carried it on till its close in 1881. In the summer of 1882 a new geological lectureship was founded in Anderson's College by Mr. James Young of Kelly, and Mr. John Young, who was an old and intimate friend of the founder, was appointed the first lecturer, and carried on the course for a number of years. During all these years he did a large amount of good work, and trained up many students to follow geological pursuits.

In 1874 he was presented by a number of his friends and well-wishers with, among other things, a life membership ticket of the London Geological Society, an honour for which, of course, his numerous writings had long previously qualified him, and in 1883 he was awarded the proceeds of the Murchison Medal Fund by the Geological Society of London, in recognition of his great services to palæontology by his researches amongst the Carboniferous fossils of the West of Scotland, this being one of the highest honours the society could give him.

In April, 1893, Mr. Young received the honour of being made a Doctor of Laws of the University of Glasgow, which, though generally thought to have been very tardily bestowed, was nevertheless much appreciated by its recipient.

As for Dr. Young's written contributions to geological science, either as sole author or jointly with others, they are so numerous that it would be simply impossible to

enumerate them here, but they remain in evidence to show us what a devoted and industrious worker he was, and to what an extent his labours must have influenced the study of geology in the West of Scotland.

By far the largest number of his papers have been published in the *Transactions* of this Society, the earliest of these being, as already stated, that on the "Geology of Campsie," published in 1860, as the first part of the *Transactions*. A second edition of it was called for in 1868, and a third, which was largely re-written, appeared in 1894.

In conjunction with his friend and fellow-worker, Mr. James Armstrong, who was at the time Secretary of the Society, he issued in 1871 "The Carboniferous Fossils of the West of Scotland," an exhaustive piece of work extending over one hundred pages, which was the basis of the more extended "Handbook of the Western Scottish Fossils," which was published for the meeting of the British Association in Glasgow in 1876, and which has served as a reliable guide for geological workers ever since.

What the Hunterian Museum owes to John Young's loving care it is not easy to estimate, but it is a very great deal. Perhaps it cannot be better stated than in the words of the obituary notice in the *Glasgow Herald*, which said, "The museum contains abundant evidence of the knowledge, zeal, and skill which have made its fossil and mineralogical departments objects of interest to men of science everywhere, while the reputation of the University was enhanced by having on its staff one whose work was as highly valued as it was widely known."

At the Hunterian Museum, or at the meetings and excursions of our Society, his knowledge was at the disposal of the humblest inquirer after geological truth, and through his ready accessibility in that way many a student has received an impetus to follow up the pursuit of the "stony science."

In collecting and determining the multitude of fossils

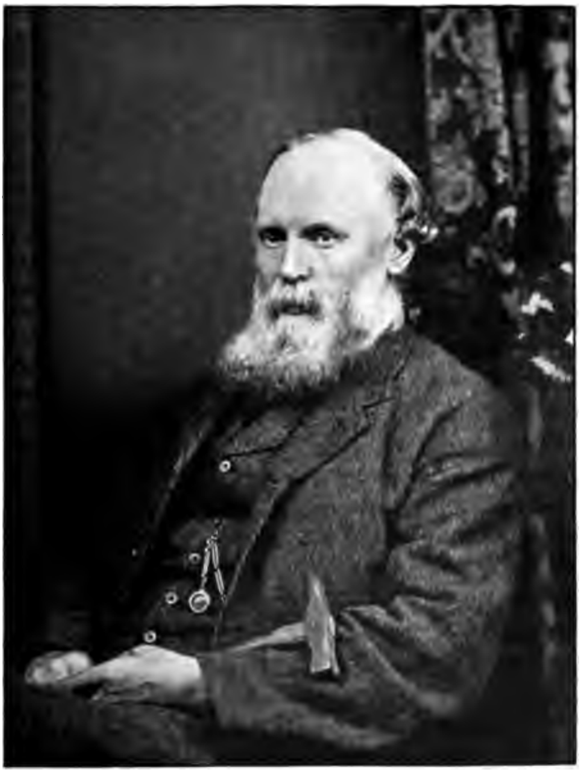
from the Carboniferous strata, not only of the vicinity of Glasgow, but throughout the rich middle basin of Scotland, from the Firth of Clyde to the Firth of Forth, he greatly advanced his favourite science. He gained much experience in the discrimination of Lamellibranchiata and Brachiopoda, studying their shell structure minutely under the microscope. Polyzoa were frequently described by him, and he made a long list of Foraminifera from the shales and limestones. In particular he published (1874) an account of the discovery of the interesting *Saccammina Carteri* in the Lower Limestone series of the Lanarkshire coalfield and elsewhere. Of the Entomostraca of his finding, many he submitted for examination to his friends, J. W. Kirkby and T. R. Jones, and his name was frequently used by them in the nomenclature of genera and species. The last instance of this friendly co-operation is in the treatment of the unique specimen found by him long ago at Robroyston, near Glasgow, and determined by his two friends, Rupert Jones and Henry Woodward, to be a peculiar phyllopod or phyllocarid with the appellation *Chœnocaris Youngii* (*Monogr. Pal. Soc.*, 1899, p. 181, pl. xxii., figs. 1a-e). Directions for collecting and mounting microzoa from the Carboniferous strata of West of Scotland were clearly given by John Young in the *Transactions* of our Society in 1867.

In the winter of 1899 Dr. Young was seized with a severe attack of illness, from which it was long feared he would not recover, but, thanks to his vigorous constitution and temperate life, he was able largely to throw off the effects, and it appeared as if he had years of occupied leisure to look forward to. By medical advice he resigned his appointment as under-keeper of the Hunterian Museum, in which post he had done such yeoman service for the institution, and retired to Troon with his unmarried daughters in the hope and expectation that he might to some extent continue his suspended palæontological work.

About the beginning of March, 1900, however, from the effects of a slight chill, his previous ailment re-asserted itself, and on the 8th of the same month he became unconscious, or nearly so, and lingered in that condition until the morning of the 13th, when he quietly passed away.

JAMES THOMSON, F.G.S.

James Thomson was born in East George Street (Paddy's Brae), Kilmarnock, on the 18th December, 1823. His father, a bootmaker, belonged to Kilmarnock, and his mother, Janet Kerr, came from Lochranza, Arran. James was the twelfth child of a family in which there were much sickness and many misfortunes. He had, at an early age, to push out for himself, so his education was very meagre. As an apprentice boot-closer he worked fourteen hours a day, and had few opportunities for self-improvement. When twenty-three years of age, he obtained work in Glasgow, and later on became traveller to a firm of tea merchants there, with whom he remained till within five years of his death. At the time of his retiral from business, his friends and associates in the various scientific societies of the West entertained him to dinner, and presented him with a cheque for one hundred pounds. On becoming, early in his Glasgow days, interested in natural science, he joined the Andersonian College, and studied, in 1855, geology under Dr. Taylor and botany under Hennedy. Geology attracted him most, and the rich Carboniferous strata of Scotland became the field of his long and arduous labours. He was at first a general collector, but he soon saw that a student, to comprehend thoroughly one of the branches of Palæontology, needed all his powers for that alone. The fossil corals of the strata just named received practically his undivided attention for the last forty years of his life, and at his death on



James Thomson, F.G.S.

14th May, 1900, he was still, as far as his impaired health would allow, engaged in his favourite pursuit.

In 1870 Thomson was a member of a committee of the British Association, consisting of Messrs. Thomson and Woodward, with Professors Duncan and Harkness, "to get cut and prepared sections of mountain limestone for photographing," and the report this committee handed in is marked in every paragraph by the results of Thomson's labours. One remark in it runs as follows:—"The great diversity of nomenclature (of fossil corals) we can only attribute to the fact that non-essential external characters have been too implicitly trusted in drawing generic distinctions. When we examine the internal structure genera named alike exhibit essential differences of conformation." Thomson at the outset of his career saw the fatal blunder made by many palæontologists, and at once adopted as his guiding principle a thorough internal as well as an external examination of the specimens he classified. The classification of Ure's corals in the "History of Rutherglen and East Kilbride" was attacked by him in this way, and though it was for a time defended by some of the authorities of those days, the true scientific value of Thomson's work was soon recognised. The elaborate series of sections he made in order to determine genera and species called forth admiration from all workers in this branch of science. Lindström, the Swedish palæontologist, as late as 1883, writing to Dr. Hunter-Selkirk, while allowing that "Thomson's sections are really wonderful," thinks he has carried this side of his work too far. But one has only to compare the vague, external characteristics used at times in Lindström's own papers for classificatory purposes with the additional wealth of internal structural details in Thomson's to recognise how much superior is the latter's method. It is the method used now in all such studies. It entails on the worker an enormous amount of labour, as much of the sectioning only proves the poor fossilisation of the specimen. It was in 1860 that he prepared his first set

of sections, and, working at these with the help of Milne-Edwards and Haimes' Memoir (Palæontographical Society, 1850-4), and papers by others, he, in 1866, read a paper to the Geological Society of Glasgow, so revolutionary in its tendency that it was not published in the *Transactions*. This, however, led to his co-operating with Dr. Duncan, secretary of the Geological Society of London, in publishing a paper in the *Quarterly Journal of the Geological Society*, November, 1867, "On Cyclophyllum, a new genus of the order *Cyathophyllidæ*, with remarks on the genus *Aulophyllum*," which earned the commendation of both Huxley and Owen. That established his position as a worker whose opinions on the subject of palæozoic corals had to be reckoned with. The paper was read on the 1st March, 1882, before the Glasgow Philosophical Society. The final result of this part of his work is interesting, both historically and for the full examination of the genera (*Cyclophyllum*, &c.) discussed. It, like all the other papers by this keen, accurate, and laborious worker, is marked by the belief that seems to have impressed itself early on his mind—that this lowly form of life, the coral polyp, lived in a world of "plastic circumstance," from which the forms evolved had often, among themselves, no hard and fast distinguishing characteristics; that change in form of structure was one of the laws of their existence; and that in them the biologist had a good example of the work done by the evolutionary forces existing in this as in all other forms of living matter. His paper, published in 1883 by the Glasgow Philosophical Society, on "The Development and Generic Relations of the Corals of the Carboniferous System of Scotland," is on more general, though similar, lines. It is, unfortunately, marred by only too many evidences of careless revision for the press. The fine paper to the Royal Irish Academy, April, 1891, "On the Genera *Cyclophyllum* and *Campophyllum*," forms the best introduction to Thomson's works and methods. It is a good commentary

on the specimens in the Dick Institute, Kilmarnock. The fine series of plates accompanying all those papers are the work of Thomson himself, who had become a skilful engraver. So strong in varieties, these varieties prove the truth of his remarks on the elusive nature of the structural details of the corals, the main cause of difficulty of a study of this subject and its fascination. This may be summed up in the lines on page 471 of the Royal Irish Academy paper—"Indeed, it never will be possible to give an intelligent definition of either the genera or species, unless the characteristics of a large series of specimens are observed. While the varieties of one species, if seen isolated or obtained from different parts of the country, might be described as different, yet when we increase the field of observation and include an extensive series, it will at once be apparent how minute are the distinctions."

For his work Thomson received several money grants from the British Association to enable him to prosecute his researches. He was made a Fellow of the Geological Society, and, owing to the warm admiration of Professor Haeckel, he was elected an Honorary Member of the Royal Ducal Society of Jena; and his correspondence with, and visits to, Belgian museums brought him the honour of being elected a Corresponding Member of the Royal Society of Science of Liège. He was Vice-President of the Glasgow Geological Society, and President of the Biological section of the Philosophical Society of Glasgow; while after his collections found a permanent resting-place in his native town, Kilmarnock conferred on him the freedom of the burgh on 9th February, 1899.

EDWARD A. WÜNSCH, F.G.S.,

was one of the original members of the Glasgow Geological Society when it was founded in 1858, and he was several times appointed Vice-President of the Society

between the years 1858 and 1881. He left Glasgow in 1881 and went to reside at Carharrack, Scorrier, Cornwall, where he died on 19th November, 1895, aged seventy-three years. The most important contribution which Mr. Wünsch made to the Society was his description of the fossil trees discovered by him in the Lower Carboniferous strata of the north-eastern part of Arran in the sea cliff about five miles north of Corrie, Laggan.* The strata in which the trees occur consist of volcanic ash, which has been ejected from some ancient carboniferous volcanoes in the same manner as Pompeii was buried by matter ejected from Vesuvius. Something like fourteen stems have been observed; they occur at two distinct levels in the tuffs, and are inclined at an angle of about 40 degs. The two sets of trees are separated by seven feet of shale and coaly matter. Mr. Binnie referred the trees to the genera *Sigillaria* and *Lepidodendron*. The trunks of several of them are from three to five feet in circumference, and their stigmarian roots could be seen spreading through the stratum below, which formed the soil upon which they grew. According to Sir Charles Lyell, the trees must have continued for years in an upright position after they were killed by the shower of volcanic ash, giving time for a partial decay of the interior, so as to afford hollow cylinders, into which the spores of plants were wafted. These spores germinated and grew, until finally their stems were petrified by carbonate of lime, like rows of the remaining portions of the wood of the original *Sigillaria* tree trunks.

In 1878 Mr. Wünsch contributed a paper to the Society, entitled "A German Professor's Views of the Geology of Arran, Translated from Professor A. von Lasaulx's 'Aus Irland,' Bonn, 1878, with Remarks."† A visit of Professor von Lasaulx, of Breslau, to the Glasgow meeting of the British Association in 1876 resulted in this work. It records chiefly the observations of the author in Ireland,

* "On the Occurrence of Fossil Trees embedded in Trappean Ash in Arran." *Trans.*, vol. ii., p. 91.

† *Trans.*, vol. vi., p. 165.

Edward A. Wünsch, F.G.S.

the last two chapters being devoted to the geology of Scotland, and the second chapter to Arran exclusively, where he carried out his investigations with great vigour. Dr. Bryce is quoted here and there, but Professor von Lasaulx does not agree with his views, and soon pushes them aside, advancing a theory of his own. In this theory the chief interest of the book centres, so far, at least, as Glasgow geologists are concerned. It had generally been assumed that the granite, breaking through the other rocks, had been the upheaving cause. But if in place of this protrusive raising force we assume a sideward pushing tangential effect of pressure, we shall find in it a theory sufficient to account for the position of the Arran granites; while the structure of the island does not correspond in the remotest degree to the assumption which attributed it to the breaking out of a massive body of eruptive rocks, such as the granite is said to be along the line of junction with the older schists. In the course of his remarks Professor von Lasaulx makes honourable mention of the prominent members of our Society, and Messrs. Armstrong, Robertson, Young, Thomson, and Wünsch are each quoted from and thanked in turn. Mr. Wünsch also contributed a paper on "Professor David Page and his Work as a Geological Writer."*

James Pinkerton Fraser.

The first President of the Society was Mr. James Pinkerton Fraser, F.R.S.E. He was elected at the first annual business meeting held in the Board-room of the Athenæum on the 7th October, 1858, and was re-elected at the second annual business meeting held in the Religious Institution Rooms on the 6th October, 1859, and was succeeded by Mr. John Scouler in 1860.

Of the personal history of Mr. Fraser very little information at this date can be obtained. He held an

* *Trans.*, vol. vi., p. 182.

important position in the City of Glasgow Bank in Virginia Street, and afterwards became inspector of branches for that bank. He was a gentleman who took a large interest in the scientific work of the city about the middle of the last century. He was one of the founders of the Natural History Society of Glasgow, and was present at their first meeting on 2nd July, 1851, when he was elected their first secretary and treasurer, and read to that society, on 6th April, 1852, "Notes Illustrative of the Geology of Part of the Shores of East Lothian and Berwickshire." He read to our own Society two papers, one on "Ice Action" and another "On the Hypothesis of Creation by Law."

The portrait is from a *carte-de-visite* by White, photographer, Glasgow, kindly lent by our Honorary Member, Mrs. Robert Gray.

Rev. H. W. Crosskey, LL.D., F.G.S.

The Rev. H. W. Crosskey, LL.D., F.G.S., was born at Lewes, in Sussex, on the 7th December, 1826. After some experience as a minister in the Midlands, he accepted in 1852 the charge of a Unitarian congregation at Glasgow, where he remained for seventeen years. Previous to coming to Glasgow, he had made some acquaintance with the science of geology, more especially with the geology of the chalk formation in the South of England. Upon coming to Glasgow, Mr. Crosskey soon made acquaintance with many of the Glasgow geologists, and became a member of the newly formed Geological Society, being elected Vice-President in 1864. He also joined the Philosophical Society of Glasgow, and served for four years as the society's honorary librarian in succession to Dr. James Bryce, of the High School. Dr. Crosskey was a most ardent student of glacial geology, and the author of a valuable series of reports on the erratic blocks of this country, communicated during a

James Pinkerton Fraser, F.R.S.E.

period of over twenty years to the British Association. He paid much attention to the post-Tertiary deposits of the Clyde Valley, and was associated with Dr. David Robertson and Dr. G. S. Brady in describing the post-Tertiary entomostraca in the Palæontographical Society's volume for 1874. He contributed a large number of papers to our Society; among these may be mentioned "On the Relation between the Glacial Deposits of Scotland and those of Canada," "Glacial Deposits of the Clyde District," a series of papers on "The post-Tertiary Fossiliferous Beds of Scotland," with Dr. D. Robertson, and a paper on "Boulder Clay." Details regarding these papers will be found in Chapter VIII. Dr. Crosskey returned to Birmingham, where he resided for twenty-four years. He died at Edgbaston on the 1st October, 1893, having nearly completed his sixty-seventh year.

JAMES BRYCE, M.A., LL.D.,

was the son of the Rev. James Bryce, and was born at Killeagoe, near Coleraine, in October, 1806. Educated at home, he subsequently entered the University of Glasgow. He distinguished himself in Greek classics, and carried off the Blackstone prize. Devoting himself to the educational profession, he was appointed superintendent of the Mathematical and Geographical Departments, Edinburgh High School. He specially distinguished himself by the researches into the geology of the Island of Arran, Bute, the Cumbraes, Skye, and Raasay. His valuable paper, "On the Jurassic Rocks of the Islands of Skye and Raasay," was read before the Geological Society of London in 1873, and it was well remarked that Bryce completed, by means of palæontology, what MacCulloch had only begun. In 1876 he contributed to the British Association Handbook for the Glasgow meeting the section dealing with the Jurassic strata of Skye and Raasay. He was appointed convener of the British

Association's Committee on Earthquakes, and described to the Edinburgh Geological Society in 1876 the ingenious appliances of which he made use in order accurately to observe and register the faintest seismic tremors. Dr. Bryce will probably be best remembered in the West of Scotland by his well-known book upon the geology of Arran and Clydesdale, which was first published in 1855, by request of the local committee of the British Association on the occasion of their meeting in Glasgow in 1855. The committee was desirous that such an account of the geological structure of the neighbourhood should be prepared as would serve for a guide to the geologists of the Association in exploring Clydesdale and the shores of the Firth, and to meet this want the book was produced. The book has long been used as a guide to the geology of Arran, and has passed through three editions. Before leaving Glasgow Dr. Bryce presented to the Society a large number of specimens of rocks and fossils principally from Skye and the north-west Highlands, and also many geological maps and sections. He was elected an honorary member of the Society in 1867. Dr. Bryce was a keen observer of Nature, and, loving the work in the field as much as in the study, he met his death whilst geologising alone among the precipitous rocks of Inverfarigaig, near Foyers, Inverness-shire, and a memorial erected by his brethren of the hammer now marks the tragic spot.

Henry W. Crosskey, LL.D., F.G.S.

Chapter X.

Biographical Notices—*Continued.*

Lord Kelvin, President 1872-1893.

The Glasgow Geological Society has enjoyed the unique distinction of having had Lord Kelvin as its president for twenty-one years, and it had the honour of issuing in its *Transactions* his important addresses on some of the fundamental problems of geology. Lord Kelvin was our President from 1872 to 1893, a period many years longer than the office has been held by any other occupant of the chair; and the fact that he was for so long willing to serve the Society testifies to his warm interest in geology.

The record in this volume of Lord Kelvin's services to the Society and to geology may be shorter than would otherwise be fitting, as a summary and bibliography of his contributions to geology, with a short reference to his life, has just been published in the current volume of the *Transactions* of the Society.* That memoir, having been prepared for the next meeting of the Society after Lord Kelvin's death, was written with the reserve due to the desire not to allow immediate feelings of loss to exaggerate the achievements of our great leader. Since then numerous biographies have appeared, and some of them were written months later and by careful experts, and by men without the local pride in Lord Kelvin that every Glasgow man must feel; but these appreciations show that we may take it as the deliberate judgment of those best qualified to judge, that Kelvin

* *Trans.*, vol. xiii. pt. ii., pp. 170-186, 1908.

will rank with Newton and Darwin as the three greatest leaders of British science.

William Thomson, afterwards Lord Kelvin, was born on the 25th of June, 1824, at Belfast. Though therefore Irish by birth, he was essentially a man of Glasgow, for his mother, Margaret Gardner, was a native of Glasgow; he was himself brought here as a child, here received the longest and probably the most important part of his education, and here wrought his great life work. Moreover, his father, though the son of a small Irish farmer at Annaghmore, County Down, received his University education in Glasgow, and came to reside here in 1832, after his appointment as Professor of Mathematics in the University. His second son, William, was brought to Glasgow when eight years old, and, after receiving his preliminary education from his father, he entered the University of Glasgow in 1834. He did not take a degree at the University, but proceeded to Cambridge in October, 1841, as a scholar of Peterhouse. He had written one original paper on the figure of the earth while a student at Glasgow, and while an undergraduate at Cambridge he wrote a series of mathematical papers for the *Cambridge and Dublin Mathematical Journal*. The time and energy devoted to this original work were diverted from preparation for his examinations, and it was characteristic of him to pursue any problem in which his interest was aroused, although it might involve the temporary abandonment of his direct work. To the great surprise of his friends, he was only second wrangler at the Mathematical Tripos in 1845; but later the same year he gained the Smith's Prize at Cambridge, and was elected a Fellow of Peterhouse. The next winter session he spent in Paris, where he worked in Regnault's laboratory, and the following year, 1846, he returned to Glasgow as Professor of Natural Philosophy at the University. The rest of his life was mainly spent in his work here. He retained his Professorship for fifty-three years, retiring in 1899; and in 1904 he was elected

Chancellor of the University, an office he held till his death.

Before Kelvin's appointment at Glasgow, Natural Philosophy had been taught by lectures only; but he instituted practical work in the subject, using a cellar for a laboratory, and in these unsuitable quarters he founded the modern school of applied electricity and inspired the development of modern physics. Most of his work was mathematical and physical, and a technical account of his influence on these sciences from the authoritative pen of Professor Lamor has been published as the obituary notice of Lord Kelvin in the *Proceedings* of the Royal Society.

Lord Kelvin was always alive to the applications of science, and he first gained public fame by his leading share in the establishment of Transatlantic telegraphy. The impossibility of transmission of electric messages across the Atlantic had been maintained on high authority. Lord Kelvin held that the scheme was possible. The first cables were successfully laid in 1857-8; but the system adopted was unsuitable. Lord Kelvin foretold the cables could not stand the electric strain placed on them, and his prediction of failure was soon verified. He, however, discovered how success was possible, and the cables laid in 1865-6, and worked on his system, achieved permanent success. Public interest in the matter was so keen that, according to a memoir by Professor Ayrton, the night train from Glasgow to London was sometimes kept waiting for Lord Kelvin when a piece of the apparatus he wanted was not quite ready. His success with the Atlantic Cable was recognised by knighthood in 1866. In 1870 the University was removed from the old College to the new buildings on Gilmorehill, and Kelvin was able to establish his school of Natural Philosophy, and undertake practical teaching work under better conditions than in the old College.

Lord Kelvin's work naturally secured him the widest public recognition. He was elected a Fellow of the

Royal Society at the early age of twenty-seven. In 1871 he was President of the British Association at the Edinburgh meeting; he was President of the Royal Society of Edinburgh in 1886-9, and of the Royal Society from 1890-1895; and at the end of his term of office in London he was re-elected President of the Royal Society of Edinburgh, an office which he held till 1907. He was created Baron Kelvin of Largs in 1892. After his death, on 17th December, 1907, with the universal approval of the nation, he was buried beside Isaac Newton in Westminster Abbey.

Lord Kelvin's closest connection with this Society was as its President, his longest Presidency of any scientific Society, from 1872-1893. His long occupation of this post shows his keen interest in geological science, on which many of his physical studies had an important bearing. Thus, his contributions to the physics of ice from 1850 to 1867, his researches on the constitution and internal structure of the earth, on the influence of the internal heat of the earth upon surface temperature, and on the causes that control climate—all had a direct connection with geological principles. His first contribution to pure geology was in 1856, when he began his campaign against the extreme uniformitarian school of geology. He realised that geological time could not be as great as some geologists assumed, as the earth was dependent for its necessary heat on the sun, the fuel supply of which is limited. The majestic slowness of geological changes inevitably led observers who watched denudation only in an old finished country like southern England to exaggerated ideas of the age of the earth. Geologists half a century ago were disposed to flourish grandiloquent estimates of time as if to rival the big figures of distances used by popular astronomical lecturers. Lord Kelvin, in a famous series of papers, showed that the sun's heat is limited, and the geological time was not infinite, and could be estimated in millions of years. He first allowed the age of the earth the elastic

limits of between twenty million and four hundred million years; but after further work he was disposed to lower the limit to between twenty and forty million years. Later investigations have, however, shown that this period was too small, and that it is at present impossible to state the age of the earth in years within limits that have any important effect on reasonable geological theory. Lord Kelvin's protest, however, was a most valuable corrective to fanciful estimates, although his work may not have given those absolute dates in geology that were promised in the title to his first geological paper. Lord Kelvin's clearest statements of his views on geological time were stated in two addresses to the Society, and published in 1868 and 1869. The following is the list of his contributions to the *Transactions*:—

1868. "On Geological Time." *Trans.*, vol. iii., part i., 1868, pp. 1-28.

1869. "Of Geological Dynamics." *Trans.*, vol. iii., part ii., 1869, pp. 215-240.

Part i.—"Reply to Professor Huxley's Address to the Geological Society of London, of 19th February, 1869," pp. 215-233.

Part ii.—"Origin and Total Amount of Plutonic Energy," pp. 233-238.

Part iii.—"Note on the Meteoric Theory of the Sun's Heat," pp. 239-240.

1877. "Geological Climate." *Trans.*, vol. v., part ii., 1877, pp. 238-250.

1879. "The Internal Condition of the Earth—as to Temperature, Fluidity, and Rigidity." *Trans.*, vol. vi., part i., 1879, pp. 38-49.

1888. "Polar Ice-caps and their Influence in Changing Sea-levels." *Trans.*, vol. viii., part ii., 1888, pp. 322-340.

Biographical Notices.

James Smith of Jordanhill, F.R.S., F.G.S.

James Smith, merchant, Biblical critic, and geologist, was descended from the Smiths of Craigend, in the parish of Strathblane, Stirlingshire. His father, Archibald Smith, coming to Glasgow, and then going to Virginia to seek his fortune, afterwards returned to Glasgow and became a partner of Leitch & Smith, West India merchants, a firm which developed a large and profitable business.

James Smith was the eldest of five children, and was born in Glasgow on the 15th of August, 1782, and died in Jordanhill on the 17th of January, 1867, in his eighty-fifth year. He was educated at the Grammar School and University of Glasgow. He was elected a member of our Society in 1859. There was evidently great joy in the young Society when it was being joined by such a distinguished man, but let the minute speak for itself—"At a meeting of the Society on the 3rd November, 1859, the President (Mr. James Pinkerton Fraser) read the following letter from Mr. James Smith of Jordanhill:—

'Jordanhill, Oct. 31st, 1859.

'Dear Sir,

'Will you kindly propose my name as a member of the Glasgow Geological Society?

'Yours faithfully,

'JAMES SMITH.'

The admittance of Mr. Smith as a member of the Society was carried by acclamation, and unanimously, and the Secretary was requested by the President to intimate the same by the first post."

He was President of our Society at the time of his death in 1867. He was a Fellow of the Royal and Geological Societies of London, and also some foreign societies. He was President of the Archæological Society of Glasgow, as well as the president of the Andersonian University, and for more than thirty years took a deep interest in its welfare; he founded the Natural History

James Smith, F.R.S.

Museum in that institution, and enriched the collection with many handsome donations.

Mr. Smith was a keen yachtsman and an able navigator, and his taste for natural history was largely developed in this pursuit. He had often as a companion in his yachting expeditions a kindred scientific spirit in the person of Dr. Scouler, of the Andersonian University, and a former President of our Society. As a Biblical critic and archæologist we do not propose to deal with him, except to mention that in the former capacity his essay on "The Sources of St. Luke's Writings" and a book on "The Voyage and Shipwreck of St. Paul" are acknowledged to be written with an accuracy and clearness of expression which have rendered them classic. It was during one of his yachting cruises that he discovered the Vitrified Fort on one of the Burnt Islands in the Kyles of Bute, which he described in a paper published by the Antiquarian Society of Edinburgh.

It is in connection with geology, however, that his name will be for ever remembered. William Smith is justly styled the Father of British Stratigraphical Geology; so James Smith may be called the Father of the post-Tertiary Geology of this country. Mr. Smith read his first paper on the subject to the Geological Society of London on the 16th November, 1836, entitled "An Indication of Changes in the Elevated Beds of Sea and Land in the West of Scotland." His epoch-making paper was read to the Wernerian Natural History Society of Edinburgh on the 26th of January, 1839, on "The Late Changes of the Relative Levels of the Land and Sea in the British Islands" (see the *Memoirs* of that society, vol. viii., p. 49, &c.). This paper was the result of careful and laborious investigations. To state it briefly, he found molluscs in the clay beds in the counties of Lanark, Renfrew, and Dumbarton, which could not be found in the adjacent seas, but were found living in the Arctic Seas. From these and other researches, says De la Beche, "Mr. Smith obtained a mass of evidence which led him to conclude,

from the remains of the molluscs discovered in deposits of this date in different localities, that the climate of the British Islands had been colder than it now is, more especially as Arctic molluscs, not now found round the British coasts, were obtained from these accumulations." The late Dr. Crosskey, in an "Address in Memory of James Smith" (see vol. ii., p. 228, of our *Transactions*), says, "These happy discoveries will connect our late President's name with the history of geology. No geological manual can be written without its chapter on the Glacial epoch, and the first page in this chapter must be ascribed to the hand of James Smith." Professor James Geikie, in his "Great Ice Age," in the chapter dealing with the Arctic shell-beds of Scotland, says, "The deposits now about to be considered are memorable in the annals of geological discovery. Mr. Smith of Jordanhill was the first to introduce them to notice, and the phenomena, as described by him, at once convinced the most sceptical that an Arctic climate had really at one time characterised our country."

Mr. Smith wrote a great number of papers on the subject, which were collected and published in one volume, entitled "Researches in Newer Pliocene and post-Tertiary Geology."

We have quoted from Dr. Crosskey's Memoir of Mr. Smith, but we would recommend those interested to read the whole of it.

It may not be out of place to mention in this notice that his son, Archibald Smith of Jordanhill, M.A., F.R.S., LL.D., was the first Scotsman who was Senior Wrangler at Cambridge.

James Croll, LL.D., F.R.S.

James Croll was one of the early members of the Glasgow Geological Society, who ultimately achieved a wide reputation in virtue of his researches on the probable cause of climatic change.

Born in 1821 at St. Martin's, Perthshire, he encountered great difficulties, like many Scotsmen, in the early part of his career. For years he tried various occupations with indifferent success, and at last obtained an appointment in the Andersonian University, Glasgow, which proved the turning point of his life. It placed within his reach the University Library and the Library of the Philosophical Society, Glasgow. It gave him leisure to pursue those studies on electricity, heat, and the physical causes of climatic change, which formed the subjects of his earlier papers. It brought him into contact with the founders of the Glasgow Geological Society, with whose aims he strongly sympathised. He took special interest in all questions connected with the glaciation of the country, for he realised that the iceberg theory was doomed, and that nearly twenty years had been lost by geologists, owing to their refusal to adopt the suggestions of Agassiz regarding the former extension of land ice in Scotland.

Accepting the land ice origin of boulder clay and moraines, Croll proceeded to deal with the question of the probable causes of climatic change. His first contribution to this subject was published in 1864, which immediately arrested the attention of Lord Kelvin, Sir Andrew Ramsay, and Sir Archibald Geikie. Through their instrumentality he was appointed Secretary to the Scottish staff of the Geological Survey in 1867—a position which he held till his retirement in 1881.

His researches on the probable causes of climatic change extended over a period of eleven years, and were published in 1875 in one volume entitled "Climate and Time." This work embodies Dr. Croll's main contributions to the scientific research of his time. His contention was that glacial cycles arise indirectly from cosmical causes. He investigated the problem of the eccentricity of the earth's orbit and its physical relations to the Glacial period. By means of Leverrier's formulæ, he calculated tables of eccentricity for three million years in the past and one

million years in the future, with the view of determining periods of high eccentricity, which, according to his theory, were coincident with cycles of extreme cold.

He next pointed out the various physical agencies affecting climate resulting from periods of high eccentricity, of which by far the most important is the deflection of ocean currents. He called special attention to the influence of the Gulf Stream as an agent in the distribution of heat on the surface of the globe. He held that a high condition of eccentricity produces an accumulation of snow and ice on the hemisphere whose winter occurs in aphelion, and that opposite effects supervene on the other hemisphere which has the winter in perihelion. When the northern hemisphere is being cooled, the north-east trade winds far exceed in strength the south-east trade winds, and thus deflect the Gulf Stream into the Southern Ocean. The deflection of this warm current, combined with other causes, would place Europe under glacial conditions, while the temperature of the Southern Ocean would be raised.

In addition to the numerous memoirs bearing on the physical causes of climatic change, he pursued other lines of research, to some of which brief allusion may be made. He tried to determine the present rate of subaerial denudation by ascertaining the quantity of sediment annually carried down by the river systems, and he further showed the value of this method as a measure of geological time. He was the first to suggest that the Scandinavian and Scottish ice-sheets coalesced on the floor of the North Sea, moving westwards towards the Atlantic, thus accounting for the marine shells and boulders of Secondary Rocks in the Caithness boulder clay. He investigated the cause of glacier motion, and advanced an ingenious explanation of his own. He also attributed the submergence during the Glacial period to the displacement of the earth's centre of gravity by a polar ice-cap.

At the close of his life he reverted to those philosophical questions which had attracted him in his early years. In

James Bennie.

his last work, "The Philosophical Basis of Evolution," issued before his death, he contended that the production of motion and the determination of motion were essentially different. He associated the phenomena of evolution with this continuous direction of motion, which, to his mind, implied will and purpose.

James Bennie.

James Bennie was born in Glasgow in 1821, and had begun his geological rambles before the institution of the Glasgow Geological Society. His schooldays were few in number, and he was early apprenticed to the trade of a handloom weaver. Thereafter he entered the service of Messrs. Kerr & Richardson, Glasgow, in whose warehouse he laboured for about twenty-one years, when he was appointed one of the fossil collectors of the Geological Survey of Scotland. His scientific career is divisible into two periods, the first comprising his work in the neighbourhood of Glasgow when he was an active member of the Glasgow Geological Society, and the second embracing his term of service on the Geological Survey.

The volume of memoranda relating to the first period, which he left, reveals his insatiable thirst for knowledge. He resolved to visit the typical fossil-bearing localities of the Carboniferous rocks, and to study the glacial deposits of the Clyde basin. In the prosecution of this work he formed lasting friendships with many of the local investigators who gathered round the Glasgow Geological Society after its foundation, especially with John Young, of the Hunterian Museum, with Armstrong, Robertson and Crosskey, with James Croll and Dugald Bell.

Mr. Bennie contributed various papers on his glacial investigations in the West of Scotland to the *Transactions of the Glasgow Geological Society*. His most important one, summarising his own results and those of Dr. Croll,

appeared in the third volume of the *Transactions* of that Society on "The Surface Geology of the District round Glasgow."

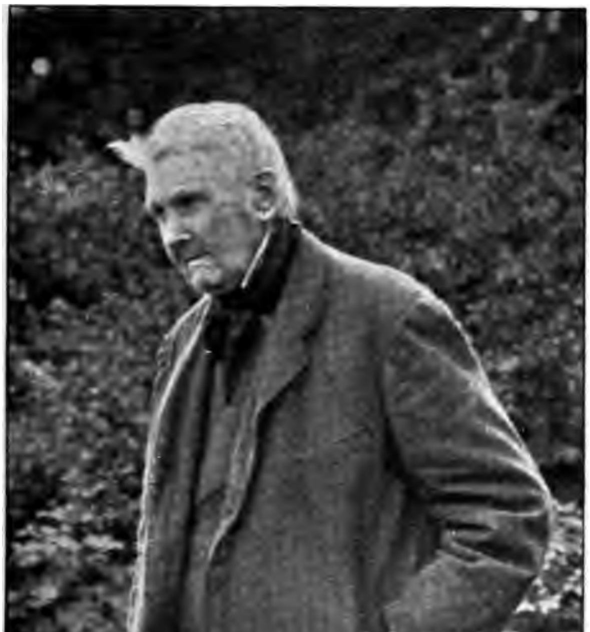
In connection with the Geological Survey, his labours were chiefly directed to searching the fossiliferous zones of the Carboniferous rocks and to the examination of glacial deposits in different parts of Scotland. His work necessarily brought him in contact with various specialists, including Mr. Etheridge, jun., Dr. Peach, Dr. Kidston, Dr. G. J. Hinde, Mr. Clement Reid, and many others. He not only furnished these men with materials for determination, but he was also able to supply valuable suggestions which yielded important results, and his own special methods of investigation led to new discoveries.

One of his important researches was carried out conjointly with Dr. Kidston, the results of which were given in a paper "On the Occurrence of Spores in the Carboniferous Formation of Scotland," published in the *Proceedings of the Royal Physical Society*. They showed that the spores present in the various coals and dirt beds, which had hitherto been regarded as *Sporangia*, were mainly true macrospores of lycopodiaceous plants, often arranged in groups of four, like those of the recent *Selaginella*.

Reference may also be made to his interesting discovery of the remains of Arctic plants in the old alluvial deposits of glacial lakes, among which may be mentioned the Arctic willow and dwarf birch. With these were associated abundant fragments of the small phyllopod, *Apus* (*Lepidurus*) *glacialis*, now confined to the fresh-water pools of Greenland and Spitzbergen.

Robert Craig,

the famous quarrymaster-geologist of Beith, was the son of William Craig, who carried on business as a lime



Robert Craig.

merchant at Broadstone and Langside, in the parish of Beith.

Robert was educated at Gateside School, and attended an evening class for a winter or two. In John Miller's "Practical Arithmetic," published in 1849, "Robert Craig, Langside," is entered as a subscriber and pupil of his. Mr. Miller was teacher in Giffen School, Beith.

He went to learn the business of quarrymaster at an early age, and turned his attention to the quarrying and burning of limestone on the lands of Broadstone and Langside, carrying on this trade for over forty years.

Mr. Craig joined the Geological Society of Glasgow in 1867, and contributed a number of papers, several of which are printed in the *Transactions*. His papers are of a high order, the notes from which they were drawn up having been made during a series of years, mostly from observations in his own quarries, especially that of Langside, but largely supplemented by notes taken in the surrounding quarries—upon which he kept a vigilant eye—as well as from general observations made in the neighbourhood.

As well as giving attention to the Carboniferous rocks of his district, he devoted some of his spare time to glacial geology, and has given us some interesting information concerning the great ice age.

During Mr. Craig's active working days as quarrymaster, no place was more frequently visited by members of the Society than Beith. There was a double attraction, Mr. Craig's own personality, and the large store of duplicate fossils to which visitors were always welcome to help themselves, so that members visiting Beith brought back two loads, one of added knowledge and another of highly prized specimens.

Mr. Craig lived to the good old age of eighty years or so, often receiving visitors and talking over matters geological long after he had given up the employment of quarrying limestone, and occasionally acted as conductor to excursion parties of the Society to places of geological interest near Beith.

Mr. Craig published a small volume of poetry, entitled "The Covenanters."

For some of the information in this short notice of Robert Craig the writer is indebted to Mr. Robert Craig, joiner, Glengarnock, and Mr. A. Shanks, Dalry.

Professor John Young, M.D., F.G.S.*

John Young was born at Edinburgh in 1835, and was educated at the High School and Edinburgh University. He entered the Medical Faculty, and graduated M.D. in 1857. After being resident physician in the infirmary for about a year, he joined the staff of the Royal Edinburgh Asylum, where he was a colleague of Dr. Yellowlees, of Glasgow. As a boy he had been a companion of Archibald and James Geikie, and their influence probably had much to do with the strong bent his mind had for natural history. In 1861 he joined the Scottish Geological Survey, his only colleagues at that time being H. H. Howell and Archibald Geikie, with A. C. Ramsay as Director for Scotland. A few months later James Geikie joined the staff, and for some years their fields of work were never far apart. Young's first duty lay in the re-survey of Fife and the Lothians for the purpose of constructing "drift" maps to supplement those illustrating the solid geology of the region. He was then transferred to Peeblesshire, where for some months he was engaged in mapping the area round the upper Tweed. Next he was stationed in St. Andrews to assist in beginning the survey of the Ochils.

In 1864 the work of the Survey was being carried on chiefly in Ayrshire, and, while crossing the Girvan Water, Young slipped on a boulder and broke his knee-pan. He refused to give his leg time to mend properly, with the

* For many of the facts the writer is indebted to the biographical notice by Dr. Yellowlees and Professor James Geikie, prefaced to "Essays and Addresses."

John Young, M.D.

result that he was slightly lamed for life. Fortunately, soon after this the Chair of Natural History in Glasgow University became vacant, and in 1866 he received the appointment. This post he held for thirty-six years, and for most of that time, in addition to his zoological work, he lectured on Geology and was Keeper of the Hunterian Museum.

Perhaps Young's most prominent characteristic was his versatility, which could not find scope enough even in these manifold duties. He organised practical work in zoology; his lectures on geology were of the most interesting and stimulating nature; he was an authority on old books and coins; he sketched and painted with considerable ability; he was an eager student of foreign literature; there was hardly a branch of science or letters in which he was not widely read. For many years before his death Professor Young was in some respects the most conspicuous figure in Glasgow University. Among the students his name was synonymous for what was unconventional, brilliant, and eccentric. Innumerable were the stories told of his sardonic wit, his disregard of accepted proprieties, his hatred of sham or pretence. In some respects opinions might differ regarding his lectures, but, at any rate, they were absolutely free from one great defect, they were never dull. His irritability was practically all assumed for his own entertainment and that of his students, who very soon got to know the immense geniality that really marked the man. The writer, who assumed a small part of Professor Young's work after his retiral, can recall with gratitude the kindliness with which he was received by him even when shattered by ill-health, and only a few months before his death.

Professor Young had the defects of his qualities. His brilliance in so many pursuits prevented him from becoming pre-eminent in any one. His chief work in geology was done in the branches of palæontology and Glacial geology. A paper well worth perusal, and one that is

eminently characteristic of the many-sidedness of the man, is "From Geology to History," which appeared in volume iii. of our *Transactions*, and which exhibits a wealth of knowledge in biology, geology, history, philology, and anthropology. Another able contribution was the notice he wrote on the death of Sir A. C. Ramsay, his old chief in the Geological Survey. Professor Young always took a keen interest in educational affairs, and in 1874 he published an admirable text-book for schools on physical geography. His contributions to our *Transactions* are as follows:—

"On Some Points in the Surface Geology of the Southern Highlands." (Abstract.) Vol. ii., pp. 266-267.

"Local Unconformity as illustrated in Sections near Bishopbriggs." (With John Young.) Vol. ii., pp. 283-291.

"From Geology to History." Vol. iii., pp. 341-367.

"Some Points in Geological Terminology." Vol. iv., pp. 109-123.

"On Mammalian Remains from Cresswell Crag Bone Caves." Vol. ix., pp. 210-212.

"The Late Sir A. C. Ramsay, Director-General of the Geological Survey of Great Britain." Vol. ix., pp. 256-263.

David Robertson, LL.D., F.L.S., F.G.S.

The story of the life of David Robertson up to within a few years of his death, written by his friend, the Rev. Thomas R. R. Stebbing, M.A., and published in 1891, renders it unnecessary to give here any lengthened account. We shall therefore give only a brief summary.

He was born in Great Hamilton Street, Glasgow, on the 28th of November, 1806; the 28th November was according to the old style of reckoning, the 9th of

David Robertson, LL.D., F.G.S.

December according to the present style. His parents were in very humble circumstances; his father died three weeks after David was born, leaving a widow and other two children, the eldest of them being only five years old. His mother, by her industry and frugality, and without any external aid, succeeded in maintaining the household and giving the children their first lessons before sending them to school. David Robertson was thus brought up until he was seven years old, when he was sent to school; he remained one year there, when he was able to read some parts of the Bible and New Testament, and had written a single page of long strokes. When eight years old he went to be a "herd laddie" with a farmer in South Lanarkshire, and continued at farm service until he was twenty-four. The lad during the winter evenings attended classes to improve his arithmetic, &c.

At this time he resolved to study for the medical profession, and to help to carry out his purpose he came to Glasgow, and, along with an old playmate, opened a school in the High Street for writing and arithmetic. This school only lasted one session. During the remainder of his college career at the Andersonian University he got employment for his spare time from a Mr. Douglas, a dyer, who also had a china shop in Jail Square. He was in good favour with his employer and family, and became engaged to one of Mr. Douglas's daughters, whom he married in 1837. Before his marriage he had given up his intention of following the medical profession, and had resolved on having a small china shop, so opened one next door to that of his father-in-law. His wife's sister about this time had been married to a Mr. M'Dougall, and the father's shop was taken over by them. The two businesses were carried on for some time, but were afterwards united under the firm-name of Robertson & M'Dougall. The firm was very successful, so much so that Mr. Robertson was able to retire in 1860. In 1839 the death of his wife was a severe blow to him, just when the business was beginning

to increase. In 1843 he married Hannah Alston, a relative of his partner's, a lady who was of great assistance to him in his scientific work, and who, we are pleased to say, still survives.

Mr. Robertson had early in life taken a fancy for some scientific pursuit. We find him in 1837 attending Mr. Craig's class on geology; he had spent the greater part of his farm service in the neighbourhood of East Kilbride, a locality rich in Carboniferous fossils. The attending this class was, one can imagine, to learn something about the fossils he had collected.

Before our Society was founded he had made the acquaintance of another kindred spirit, that of the Rev. Henry W. Crosskey. This was fortunate for both, and our Society's *Transactions* are enriched with the result of their joint labours. After years of patient research the series of papers, "The post-Tertiary Fossiliferous Beds of Scotland," was given to our Society (see vols. ii. to v., 1867 to 1873). In addition to those papers jointly with Mr. Crosskey, he contributed on his own account other eight papers, which are to be found in vols. iv. to viii. For a bibliography of his contributions to scientific literature, see the appendix to his biography, p. 385.

He did a vast amount of work for the Natural History Society of Glasgow, which society he joined soon after it was formed, and was president from 1887 to 1890. He was also a Fellow of the Linnæan and Geological Societies of London, and in 1895 the University of Glasgow conferred upon him the honorary degree of LL.D. He also took a great interest in founding the Marine Biological Station at Millport.

Dr. Robertson's success from herd laddie to farm servant, school teacher, medical student, successful merchant, and distinguished man of science was entirely due to his "energy and perseverance, honesty of purpose, genial friendliness of heart, and openness of mind."

He died on the 20th of November, 1896, nearly completing ninety years, and is buried in the cemetery at Cumbrae Cathedral.

Biographical Notices.

Thomas Davidson, LL.D., F.R.S., F.G.S.*

Dr. Davidson was born at Edinburgh in 1817. He studied at Paris, and afterwards entered Edinburgh University. By the advice of Von Buch, he devoted himself specially to the study of Brachiopoda, which study eventually became the business of his life.

Dr. Davidson was elected the first honorary member of our Society in 1859, the second year of its existence. It was in the year 1856, when he began to gather material for his monograph on the Carboniferous Brachiopoda of the British Isles, that the members first made his acquaintance. Previous to this he had completed, between the years 1851 and 1854, the first quarto volume of British Brachiopoda for the Palæontographical Society, comprising the Tertiary and Secondary species.

After coming to Glasgow, in 1859, Dr. John Young pressed upon Dr. Davidson the importance of preparing a short descriptive monograph of the Scottish Carboniferous Brachiopoda, with plates, and this he kindly consented to do, having in the meantime been elected an honorary member of our Society, an honour which all his life he highly appreciated.

This monograph of the Carboniferous Brachiopoda of Scotland is a very valuable little work. It appeared in the *Geologist* (now the *Geological Magazine*) during the years 1859, 1860, with the following title:—"The Carboniferous System of Scotland, characterised by its Brachiopoda. By Thomas Davidson, F.R.S., F.G.S., Honorary Member of the Geological Society of Glasgow, &c., &c." In the introduction reference is made to the many eminent Scotchmen who have "contributed to elevate the science of geology to the rank it now holds among all men of learning"; and it further states that "much has, however, still to be achieved before the geological and palæontological details connected with our

* Contributed to the Society by Dr. John Young, and printed in the *Transactions*, vol. viii., p. 138.

country will have been completely worked out. I therefore hailed with much hope and delight the foundation of a Geological Society in Glasgow, which originated in May, 1858, with about a dozen young men, who wished to gain knowledge of the geological phenomena in the neighbourhood of their great city. The Society has already done some good work, and increased its numbers to about one hundred." The author further refers to the palæontological riches of some of our rocks, and says, "I here attempt the publication of a special illustrated catalogue or monograph of all the Scottish species of Brachiopoda that have been hitherto obtained from the strata of the Carboniferous period; and this I have undertaken in the hope that by so doing it may stimulate and facilitate further researches, as well as prove of some assistance to those friends in Scotland to whom I am personally indebted for the gift and loan of the valuable series of specimens which will be made use of in the present memoir."

In the year 1868 he also prepared a quarto paper of twenty-one pages, with three plates of figures, on the "Upper Silurian Brachiopoda from the Pentland Hills." This was printed, and was intended to form the first part of a projected palæontological series on Scottish fossils, to be issued by a committee of members of this Society, but the scheme was never further carried out.

During the long series of years that Dr. Davidson was engaged upon his great work on the Brachiopoda he was a hard worker and methodical investigator, grudging every day that he could not devote to it. He generally worked from six to eight or even ten hours per day, and at one period he wrote me often that he was very much afraid his health and sight would break down from the long-continued strain before he had finished on the stone all the plates for his monograph. The desire to see this great work completed was his constant aim during the later years of his life, and, happily, with care, this wish was accomplished. He had a warm regard for everything

Scottish, and often in his letters he expressed a desire to visit "dear old Scotland" more frequently than he was able to do, but it was very seldom that he ever was tempted to tear himself away from his engrossing work. On one of his visits to his estates in Midlothian he came for a day and night to Glasgow, and was entertained to dinner by members of this Society in one of the hotels of the city. This was in the year 1863 or 1864.

After having finished his series of monographs on the Brachiopoda of the several British formations in 1871, he again returned to the work in a series of supplements, in which he figured, and described, all the additional species or varieties that in the interval had been discovered, or of which better preserved examples had been found. It is in these supplements that he was enabled to do full justice to all that had been discovered in Scotland in the strata of the Carboniferous and Silurian formations, and it is here that was found the full value of the special Carboniferous monograph to which I have already referred, as members of this Society were thereby enabled to add to its list of Scottish Carboniferous Brachiopoda all the later-discovered species. In the introduction to his Supplement of Carboniferous forms, p. 249, he states that "eleven other species had been discovered, described, and illustrated that were either new to science or new to Great Britain." In the same interval of time eight species were added to the Irish list, while none were added to the English.

It gave Dr. Davidson the utmost pleasure to be able to illustrate so many genera and species of Brachiopoda from the Silurian strata of the Girvan district, the result of the careful collecting of Mrs. Robert Gray and others. At p. 220 of his Silurian supplement he sums up all the Scottish species of Brachiopoda which had come under his observation from the several formations, including the Recent period. These are, in all, as follows:—4 Recent, 2 Post-tertiary, 17 Liassic and Oolitic, 59 Carboniferous, and about 134 Silurian species, making a grand total of

216 so-termed species. "This," he says, "is a large number from a country that had been so long considered as scarcely fossiliferous in this respect. And, when it is borne in mind that it is only from the Jurassic, Carboniferous, and Silurian formations that Scottish Brachiopoda have been obtained, the number of species is certainly remarkable."

Dr. Davidson completed the last supplement to his series of monographs in 1884, having been nearly thirty-four years engaged on the work. It forms a bibliography of all the papers known to have been written on this group of the Mollusca, from the first notice in 1806 down to the date of the publication, and fills one hundred and sixty-three quarto pages. This bibliography he considered an important piece of work, the materials for which he had been collecting for years, and he told me that, as it had cost him a great deal of time and research, he hoped it would be of use to all subsequent investigators of the Brachiopoda by acquainting them with what had already been written on the subject.

During the long series of years in which Dr. Davidson was engaged in describing and illustrating the fossil Brachiopoda, he at the same time was quietly assembling a collection of the Recent forms from all the seas of the world where they could be obtained. Of all the species of these he had already drawn illustrations ready to be placed on the stone for printing, and had likewise written out the necessary descriptions. They will fill a large quarto volume, which he had arranged, previous to his decease, should be printed for the Linnæan Society of London, of which he had long been a distinguished member.

Having stated thus much regarding Dr. Davidson's life-work, and especially his work in connection with the Geological Society of Glasgow and the Scottish fossil Brachiopoda, I will now only refer those who wish a fuller sketch of his scientific career to an article in the *Geological Magazine* for April, 1871, entitled "Eminent

Living Geologists: Sketch of the Scientific Life of Thomas Davidson, F.R.S., with portrait." In that sketch they will learn that upwards of thirty scientific societies all over the world did themselves the honour of placing his name on their list of honorary members. Also, that up to that date he had written no less than some forty-nine distinct works or papers on the Brachiopoda, which fill some 2220 pages, accompanied by 244 plates of figures, all drawn and placed on stone ready for the printers by his own hands. Surely such long-continued industry, coupled with so much talent and enthusiasm, may well call forth the highest esteem and admiration for our departed honorary member. Dr. Davidson died on 14th October, 1885, at his Brighton residence, after an illness of some duration.

Professor Laurent-Guillaume de Koninck.*

Laurent-Guillaume de Koninck, Doctor of Medicine and Professor of the University of Liège, a most distinguished palæontologist, and an eminent chemist, was born at Louvain, in Belgium, on 3rd May, 1809, and, entering the University of his native town, studied for the medical profession. On the completion of his curriculum, at an early age, he took the degree of Doctor of Medicine, with honours in other departments of scientific inquiry. In 1834 his eminence as a student attracted the attention of the Government, and, in order that he might travel and acquire a knowledge of chemistry in other countries, he was at its expense sent to travel. At Paris he studied in the laboratories of Gay-Lussac and Thenard, at Berlin with Mitscherlich, and with Baron de Liebig at Giessen. In 1835 he was elected a Fellow of the University of Ghent, and placed in charge of the course of industrial chemistry. His removal to Liège towards the end of the following year was at his own request, and there he

* Contributed to the Society by James Thomson, F.G.S., and printed in the *Transactions*, vol. viii., p. 308.

taught organic chemistry. In December of the same year the Royal Academy of Sciences of Belgium elected him a corresponding member, his nomination as member dating from 1842. Though he worked assiduously, both as student and as teacher of chemistry, and made some important discoveries in that department of science, he found time in the intervals between his numerous duties to study the Carboniferous fauna of Belgium. He was a close observer, a careful collector, and a painstaking note-taker, the most minute differences in structural details being carefully examined and recorded.

With that eminently characteristic industry which distinguished him throughout his long and honourable career, he soon acquired sufficient data to warrant the issue of his first palæontological paper in 1837. Amongst his numerous contributions to science, both chemical and palæontological, his well-known "Descriptions des Animaux Fossiles qui se trouvent dans le Terrain Carbonifère de Belgique," in two volumes, with a supplement, which appeared between the years 1842 and 1851, is indispensable to the student.

His fame became more widely known, both as a chemist and as a palæontologist, inducing not only his own countrymen, but also those of other nations to confer upon him numerous honours. In 1846 he was elected Knight of the Legion of Honour, and in 1852 had the Order of Leopold conferred upon him, also the Order of the Red Eagle of Prussia. As a mark of their appreciation of his researches, the Kings of Prussia and Italy awarded him their great gold medal for his important scientific works, honours awarded only to the most distinguished scientific men. In 1853 he was awarded the Wollaston Fund to aid him in his important researches, and in the same year he was elected one of the Foreign Members of the Geological Society of London. Professor de Koninck was member, or corresponding member, of numerous learned societies, amongst others the Academy of Medicine of Belgium; the Academy of Sciences of

Turin and of Munich; the Geological Societies of London, Berlin, and Dublin; the Philomathic Society of Paris; the Imperial Society of Naturalists of Moscow; the Imperial Mineralogical Society of St. Petersburg; the Dutch Society of Sciences of Haarlem; the American Philosophical Society of Philadelphia, &c., &c. On several occasions he was selected by the Belgian Government to adjudicate on the merits of competitors for scientific honours, and in 1862 he was delegated to report on the chemical products exhibited at the International Exhibition of that year in London. Professor de Koninck's first publication appeared in 1833, when he was comparatively a young man, and during the intervening period till 1887 he issued not less than from sixty to seventy separate memoirs, some of which were exhaustive and extensive in their character, and bearing the imprint of originality and care, became indispensable adjuncts to the working palæontologist. But he did not live to finish his colossal work on the fauna of the Carboniferous Limestone of Belgium, which was intended to be a summary of all his investigations of the fauna of that system. He had completed the descriptions of the Fishes, the Cephalopoda, the Gastropoda, and the Lamellibranchiata, forming volumes 2, 5, 6, 8, and 11. The volume containing descriptions of the Brachiopoda was also nearly completed. In the last letter I had the honour of receiving from him shortly before his lamented death, he feelingly refers to his continued illness from brain fever, and his inability to continue his investigations; and he pathetically states that he had only twenty-seven species of Brachiopoda to describe to complete his memoir of that group. Had he lived to finish this great work it would have been (and is, so far as it goes) the most exhaustive palæontological treatise that has ever been issued. Even in its fragmentary state it places the author in the eminent position of ranking with his late, and often referred to, friends, Professor Louis Agassiz and Dr. Thomas Davidson, F.R.S.

Biographical Notices.

The memoir by Professor de Koninck on the corals of the Carboniferous system, 1872, "Recherches sur les Animaux Fossiles du Terrain Carbonifère de la Belgique," is an important addition to the knowledge of that group of fossil remains, and bears the impress of careful work. His additions to our knowledge of the simpler groups, notably the genera *Amplexus* and *Zaphrentis*, are invaluable to the student of corals. Had he lived to overtake a general review of the corals he would have made some alterations, arising from a careful examination of sectioned forms which he made when visiting the writer in 1877. After examining the structural details of the genus *Amplexus*, and the nearly related *Caleophyllum* of Dana, and their merging into the genus *Campophyllum*, he was persuaded that the line of demarcation was extremely minute, and could only be determined by the thorough examination of sectioned specimens. This led to his types of fossil corals being sent to me for comparison and identification with our Scotch specimens, the result enabling us to identify not only a number of species, but, if he had lived, would have resulted in a more intimate relationship to revise and complete the classification of the group.

Professor de Koninck was alike distinguished by his scholarly attainments, purity of motives, and transparency of character. Information received, even from the humblest source, was not only gratefully acknowledged, but found a place in his masterly works. In the long and pleasant correspondence with which I was honoured, there were frequent references to even the most trifling information received from his numerous correspondents. His intense desire to add something new had no influence in inducing him to withhold honourable mention of the discoverer, as is sometimes done. He, like his late friends, Louis Agassiz and Thomas Davidson and such eminent scientific workers, have been, and are, indebted to the provincial and practical field workers, and with all such men the recording of discoveries, no

matter by whom they are made, finds a prominent place in their published works. From the sagacity displayed in the definition and arrangement of genera and species in his great work already referred to, which appeared in 1842 and 1851, Professor de Koninck's reputation rapidly spread to such a degree that fossils were sent to him for identification from all parts of the world, his careful examination of the most minute details, and comparison with examples from other countries, enabling him to identify forms with a wonderful degree of certainty. Thus the fame of his careful work not only added to his own reputation, but also aided all palæontologists, wherever they might be located, to identify genera and species with great certainty. As in all human work, there will be doubtless modifications and additions to his colossal labours, arising principally from the imperfect geological record. New forms will be discovered and new facts revealed, which will necessitate a re-arrangement of the great author's works. Yet what Professor de Koninck has left as his contribution to the cairn of intellectuality is, and will continue to be, regarded as a never-dying tribute to his world-wide fame. The Council of the Geological Society of London conferred upon him in 1875 the Wollaston medal, one of the highest honours in their power to bestow. In 1872 he was unanimously elected an honorary member of this Society, and ever evinced a great interest in its welfare. Professor de Koninck died on the 16th July, 1887.

Chapter XI.

Biographical Notices—*Continued.*

Robert Slimon, M.D.

Standing on Nutberry Hill (1912 feet), the highest of a ridge of hills on the boundary of Lanarkshire and Ayrshire, and almost in a direct line between Muirkirk and Lesmahagow, looking north one sees the whole valley of the Logan. At the foot is Logan House, a place in which the Covenanters took counsel in troublous times. A little farther north is a clump of trees, where, it is said, once stood Shanks Castle, although now no ruin of any kind is to be seen. Farther north, again, on Dunside Rig, is the ruin of what seems to have been a place of some importance, although at what time is not known. It is not noted in the Survey maps, nor can I find any literature regarding it. To the left of Logan House are the Kip and Blackberry Burns; to the right the Long Burn, and right in front, near Dunside, is Blaeberry Burn. East of Logan House is the source of Birkenhead Burn, which joins the Logan just before the latter joins the Nethan. Rocks in all these places have yielded fossils. Near Dunside *Pterygotus* occurs; at Shanks Castle *Ceratiocaris* and *Slimonia;* and in the burns, shells, fishes, and scorpions. Surveying the landscape from the top of Nutberry Hill, in the foreground we have "mosses, waters, slaps, and stiles," yet in the distance lies perhaps the finest view of the valley of the Clyde to be had anywhere. Although this district is now the home of the plover and curlew, there is evidence from the many ruined homesteads that at one time it was not so deserted.

The first to discover organic remains on the Logan Water was a farmer's boy named James Fallow, who was

Robert Slimon, M.D.

born at South Brackenridge, Lesmahagow, in or about 1827. This place is near the Logan Water. Dr. Hunter, in his biographical sketch of the late Dr. Slimon, speaks of Fallow as follows:—"He used to steal away, his mother has told me, up the water, hammer in hand, to collect the 'curious stanes,' as he termed the fossils, much to the annoyance of his father, who found fault with him, and prohibited him from going back to his absurd employment. He was, however, far too deeply engrossed in his pursuits to resist the attraction, and, as a keen geologist, continued to collect specimens from his favourite Logan Water till a few days before he left for New Zealand, in 1881. He had been working at these rocks more or less since 1840 or 1843, but had never during all that time come into contact with any geologist, so far as his mother knew, except Dr. Slimon. His name never became known to fame, as it might otherwise have done." He was a most diligent and intelligent observer, and an enthusiastic geologist. He might have had a very fine collection had not Dr. Slimon and the late Dr. Hunter-Selkirk, as he said, "herried my nest." Mr. Fallow himself tells how Dr. Hunter used to put one of his fine specimens of *Pterygotus* under his coat and say, when going away, "I'll call this one Fallowensis." On leaving for New Zealand, in 1881, he gave to Dr. Hunter the first specimen he had found on the Logan Water, and it is now in the Kilmarnock Museum. No doubt it was James Fallow who was the first discoverer of the Logan Water Crustaceans, and it is but right he should be known as such. He is still living in New Zealand, and has a nice farm of his own at Thornbury, Southland. His greatest ambition is to come home and spend a day or two on the Logan Water, but he says he is too old now. Fallow collected his first specimens on the Logan Water between 1840 and 1843, and Dr. Slimon in 1851.

The first man to bring the discoveries of the Logan Water before the public was Dr. Slimon, of Lesmahagow.

Of Dr. Slimon's early life very little is known, and the following facts have been mostly collected from Dr. Hunter's paper to the Geological Society of Glasgow:— He was born on the 16th October, 1803, at Douglas, in Lanarkshire. His father, John Slimon, labourer in Douglas, was married to Marian Kennedy on the 3rd June, 1797, and there were five children born of the marriage, Robert being the third. His father died when Robert was very young, and the future doctor began his working life as a handloom weaver with a Mr. Bow in his native village. Leaving this trade, he took up that of a bookbinder, for which there was surely not much scope in Douglas. He next removed to Cumnock, and worked as a snuffbox maker, but after some time migrated to Glasgow, employing in the same business a number of hands. Whether this business was successful or not I am unable to say, but Slimon next obtained a situation in a druggist's shop, and, while serving here, attended the classes in Stirling's Medical School. He afterwards lived at Crossford, near Lanark, and then at Lesmahagow. He went back again to Glasgow, and afterwards settled down for life at Lesmahagow. He probably practised as a doctor at all three places. In 1864 he received the diploma of the Faculty of Physicians and Surgeons of Glasgow, and in 1869 was elected a corresponding member of the Geological Society of Glasgow. Although he was a corresponding member for fifteen years, it does not appear that he read any paper to it. The only paper he published was a short account of the geology of the parish of Lesmahagow, in "The Annals of the Parish of Lesmahagow," by Mr. Greenshields of Kerse. From this paper he appears to have had a good grasp of his subject, as the minuteness and extent of his knowledge are shown in its details. It is said he began the study of geology from reading an elementary work on the subject. He had collected specimens from the Carboniferous rocks at Boghead, Auchenbeg, and other localities long before he knew of the famous Crustaceans on the Logan Water.

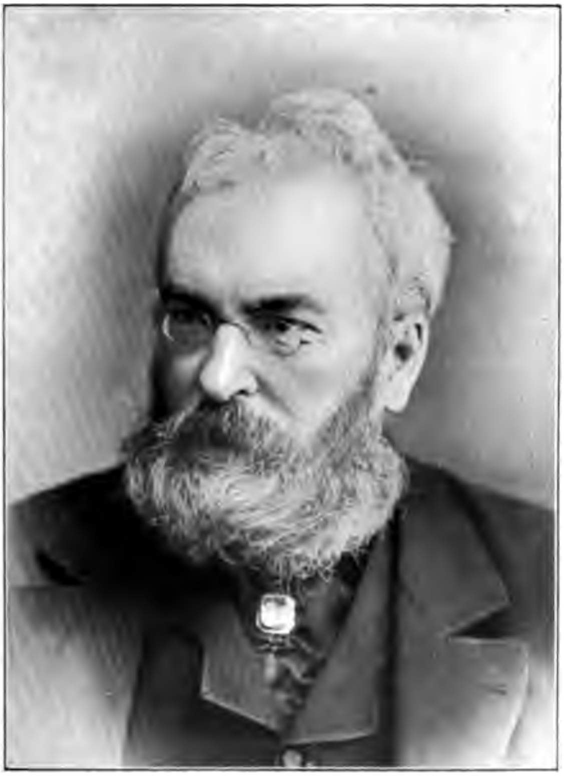
At the meeting of the British Association at Glasgow in 1855 a series of remarkable fossils from the moory uplands of Lanarkshire was shown for the inspection of the learned. Sir Roderick Murchison was so interested in them that, as soon as the meeting was over, along with Professor Ramsay, under the guidance of Dr. Slimon, he visited the spot, and the general results of this rapid raid he told to Professor Harkness. "I came last night direct from the Lesmahagow country, where I passed two entire days with the good Slimon. I took Ramsay with me. We had glorious weather. I am more satisfied with my general results than anything I have seen for many a day. The merit of this discovery belongs to Slimon, and I shall raise a statue to him for it. As I had a very fast horse to take me from point to point, I used my legs up every burn (including all the Carboniferous series to the east), and to the top of Nutberry and considerably to the west of it. I have no doubt as to the completeness of the evidence. When Salter has examined the fossils I will tell you more. In the meantime I have left Slimon the happiest man possible, and I intend (*D.V.*) to give a little introduction to the description of the wonderful geological parish of Lesmahagow and the merits of the poor but meritorious Dr. Slimon, who, if he had been rich enough to visit his patients on a horse, and had not travelled up the braes on foot, would never have made this excellent hit." A great many of the fine specimens procured by Dr. Slimon are to be found in the British Museum and in other collections, and the late Mr. Salter described and figured at that time the most interesting species of the Lanarkshire Crustaceans under the generic names of *Himantopteris* and *Pterygotus* in the *Quarterly Journal of the Geological Society of London.* He also gave a drawing of the Phyllopod crustacean *Ceratiocaris,* with the body and tail spines attached, thus demolishing the theory of the tail spines being fish defences, as was believed at that time by many geologists. In a report on the geology of Lesmahagow made by Sir Roderick

Murchison to the British Association in 1859, Dr. Slimon's observations were embodied, and his labours as a geologist were deservedly mentioned with honour.

Dr. Slimon was not only an enthusiast in geology, but a devoted astronomer and an admirable amateur artist, and at one time gave two lectures in the City Hall, entitled "Astronomical Geology." He died at Lesmahagow on the 12th October, 1882, and at the time of his death had reached his eightieth year. Some years before Dr. Slimon died Dr. Hunter had started his explorations on the Logan Water. He called at Slimon's house on his way to the Logan Water, only two or three months before the death of the doctor.

J. R. S. Hunter-Selkirk, LL.D.

Dr. Hunter-Selkirk was born at Edinburgh on 13th March, 1835, but spent most of his life from boyhood upwards in the Carluke district. A fortunate connection with the Selkirk family assisted to smooth for him the path of advancement, and led ultimately to his marriage with a lady of that name, Miss Mary Selkirk. When about ten years of age he read the Life of John Hunter, the eminent anatomist and founder of the Hunterian Museum, Glasgow. The work so fired the imagination of the boy that he resolved to form a collection larger than that of the eighteenth-century savant, or, indeed, of any one else in Scotland. Amply did he try to fulfil his boyhood's vow, for the Braidwood collection is one of the most important ever brought together in this country by a private individual. He was a collector, a veritable Nimrod, " a mighty Hunter " in the realms of the curious and the antique. His geological treasures from the Silurian and Carboniferous formations are not easily equalled by any private collection. When quite a child he began to lay the foundations of his large collection. Many a time he exchanged the lunch which he carried



John R. S. Hunter-Selkirk, LL.D.

to school for a bad bawbee, forgetting the pangs of hunger in the frequent inspection of his treasure. There is still a fossil *Nautilus* in his collection, which was among the earliest of his acquisitions. He found it lying among some rubbish in a garden, and very conscientiously showed it to the proprietor, who permitted him to keep it. After his schooldays were over he studied both for the law and medicine, but ultimately gave them up as not being congenial to his tastes. About this time (1855) he published a series of letters in the *Airdrie Advertiser* on "The Shortness of Wagons with the Railway Companies," "Cock Fights," "The Abolition of the Stamp Duty," &c., &c. He then started as a coal agent with a man named Barr, the firm being known as Barr & Hunter. The partnership was dissolved in June, 1869. During the previous summer he had visited America and travelled through a large part of the "Wild West," having the honorary degrees of LL.D. and D.Sc. conferred upon him by the University of Philadelphia in recognition of his scientific labours. He used to tell of an experience he had when in America with General Morgan, one of the leaders in the War of Secession. Both were staying in a Kansas hotel at the same time, and on one occasion a heated discussion arose between them on the war, which so tried the temper of the American that, in a moment of passion, he was about to resort to the use of his revolver. However, the cool and plucky action of the doctor, who, foreseeing the probable course of events, already had the advantage of his opponent, caused the latter to retire in confusion. Next day the general apologised to Dr. Hunter-Selkirk, complimenting him for his real British pluck. "Scotch," replied the doctor, correcting him as they shook hands heartily. During the rest of his stay in Kansas Morgan became much attached to Dr. Hunter-Selkirk, and in parting they exchanged photographs. It is to be hoped that the Westerner was afterwards more careful not to insult a man till certain that he was not a Scotsman. A leading trait of the doctor's character was the intensity of his

patriotism. He was a firm believer in the superiority of Scotland and its people over the rest of the world. Under the most exciting circumstances of personal danger, he never forgot this article of his creed. After his return from America he joined in partnership with Dr. Selkirk in the Braidwood Coal, Lime, and Coke Company, and, as he had a colliery manager's certificate signed by the Secretary of State for Scotland, he acted as manager for the company. It is said that the coal produced splendid coke, and that it brought five shillings more per ton than the coke made in the Slamannan district. One day, not long after he started, a new rope had been placed on the drum at the pithead for winding purposes. The first person thereafter sent down was an Irishman; by an oversight, the engineman forgot to uncoil the rope, with the result that the unlucky son of Erin descended the shaft with the speed of a plummet. He escaped, however, with a few bruises and a shake to his nerves. When the man's wounds had been attended to and some "spirituous" comfort administered the alarm subsided, and the doctor resumed conversation with a friend. Paddy was reclining within earshot, and, overhearing allusion made to a Bible four hundred years old which the doctor himself had bought, he raised his head, fixed a pair of wondering eyes upon his employer, and asked in awe-struck tones, "Faith, doctor, and did yez buy it when it was new?" The limestone in the pit was peculiarly rich in fossils, a fact which aroused the attention of Dr. Selkirk and prompted him to begin a collection. But another Richmond was in the field. His more enthusiastic partner, by dint of early rising and a liberal allowance of "backsheesh," secured the best specimens that were turned up daily. The consequence was that, when Dr. Selkirk appeared at the pit every morning at eleven o'clock, there was nothing left for him to appropriate. Years passed. Both gentlemen went on forming collections, but, while that of Dr. Hunter began to assume imposing proportions, Dr. Selkirk's increased but slowly. One day the latter called on his successful

rival. "Come up and take away these fossils," he exclaimed, in tones of mingled chagrin and disgust. This request was instantly complied with, and two cart-loads of fine specimens were thereby added to Dr. Hunter's treasures. Needless to say, Dr. Selkirk from that day gave up all his dreams of a collection; and after this, in recognition of Dr. Selkirk's gifts, Dr. Hunter resolved to call his collection the "Braidwood Collection," as part of Dr. Selkirk's money and time helped to make it what it was.

When Dr. Hunter married he lived first at Midloan. He then purchased the estate of Daleville. The house is a plain but commodious country mansion on the right bank of the Clyde, within half a mile of the river. The original two-storey house, built about fifty years ago, now forms only the rear part of the mansion, the larger front part, containing the principal rooms, having been added at a later date by Dr. Hunter. The grounds have a steep southern exposure, and are tastefully laid out with avenues and winding walks. The shrubberies consist mainly of laurel, yew, holly, arbor vitæ, &c. They are trimly kept, and lend a picturesque charm to the place. This romantic feeling is further enhanced by the presence of the Braidwood Burn, a rapid little stream that leaps and dances along a rocky, fern-clad ravine, overshadowed in summer by the dense green foliage of the trees, forming one of Nature's loveliest retreats. About 300 yards distant from the house is the tower and fortalice of Braidwood, an ancient ruin with important historical associations. Here, according to Blind Harry, Sir William Wallace stayed for three days assembling an armed force, which followed him to Mauldslie, and there proclaimed him Governor of Scotland.

After settling down at Daleville Dr. Hunter's real work may be said to have begun. At this time the Palacecraig, Quarter, and Carnbroe ironstone pits were in full swing. The *Labyrinthodontia* were turning up. A schoolmaster near Hamilton had been collecting them when Thomson and Hunter got word of it. Thomson was first on the

spot, and got them all with him. Next day the doctor made his appearance, but all too late. One day when he was in the Carnbroe district, so rich in fossil fish, he had collected more of them than he could carry. He asked a boy whom he chanced to meet to help him. "I'll do that, sir," was the obliging reply. "But what are we to carry them in?" inquired our geologist. "Please, sir, my mither has a big claes-basket," replied the boy readily; "you could get the len' o' it." The basket was procured and filled with fossils instead of family linen, and the two, seizing a handle each, set off slowly for the railway station. Slowly, we say, for the contents of the basket were as heavy as Blackband ironstone, and after every few steps the load had to be laid down, giving the indomitable boy another opportunity to spit vigorously on his hands. As the train was nearly due, the pair clambered with their burden upon the line for a short cut. This strategic move, however, only added to the length of the journey, for, after proceeding some distance, they were stopped by a railway official and sent back to the starting-point of their unlawful deviation. With many blessings on that particular railway company, the doctor and his faithful henchman struggled on, with fewer pauses than before. The sweat ran down their faces, and at every step the edge of the basket bumped against their weary legs. Happily the train was not gone when they staggered on to the platform, and the plucky lad was dismissed with a gratuity that made him forget his muscular exhaustion and loss of saliva. Dr. Hunter not only collected fossils, but about this time (1870 to 1874) he produced a paper on "Vertical Sections of Carboniferous Strata in the West of Scotland," Part 1 and Part 2, and at this time he read a paper to the Geological Society of Edinburgh on "The Geology of the Carboniferous Strata of Carluke." In 1864 he was made a member of the Geological Society of Glasgow, and in 1879 he was made an honorary member of that Society. For many years he contributed to its *Transactions* papers of local and scientific interest, "The Old Red Sandstone

of Lanarkshire, with Notes on Volcanic Action during Old Red and Carboniferous Times," "Notes on a Fossil Scorpion in the Silurian Strata of the Logan Water," and also a comprehensive paper on "The Silurian Rocks of the Logan Water," "The Geology and Palæontology of Bankend, Bellfield, Coalburn, and Lesmahagow," "Three Months' Tent Life on the Silurian Hills," "A Biographical Sketch of Dr. Robert Slimon," "Craignethan and its Vicinity." On many occasions he was leader of the excursions and picnics of various societies. Apart from his scientific pursuits, he took a keen interest in all matters of rural enterprise, and is said to have been the first person in Clydesdale to grow strawberries for the market. By advice and example he led the way to a renewal of prosperity to the impoverished cultivators of Clydesdale, and to-day from sixty to seventy van-loads of the luscious fruit are despatched daily to Glasgow during the season.

In 1888, after a lingering illness, his wife died. This was a sad blow to him, and it may be said he did very little scientific work after. In 1894 he was presented with a life-size portrait of himself by his numerous friends in the leading circles of art and science in Scotland, and also with an autograph album containing a number of fine sketches in water-colour by distinguished artists, a pen-and-ink cartoon representing the doctor in the guise of a "Prehistoric Hunter" soaring on the back of a Pterodactyle, and an array of autographs, including those of Lord Kelvin, Sir James Bell, Sir William Hozier, Professors Geikie, Jones, Hunter, Dougall, &c., &c. In 1895 he was presented with the freedom of the burgh of Airdrie for his gifts to the museum, and a marble tablet was erected in the reading room in recognition of his gifts. Some years before his death he presented a fine series of minerals to Kilmarnock, and shortly before his death the larger part of his great collection; the other part went to Lanark. In his last illness, which took place at Christmas, 1897, he bore his troubles well, and lingered on till the 23rd March, 1898, when, speaking

of his collection, he frequently grew animated; then his voice increased in volume, and amid the wreck of Nature you could still see lingering the force, the fire, the insight, and the individuality that always accompany genius.

The work on the Logan Water is still being carried on. In 1896 Mr. James Young, of Lesmahagow, collected a specimen of *Thelodus*, which led the Geological Survey in 1897-8 to send Messrs. Macconochie and Tait, and their efforts resulted in what may be said to be the greatest discovery in modern times of fossil fish.

Since then Mr. David Nimmo has established a camp on the Logan Water and is doing good work.

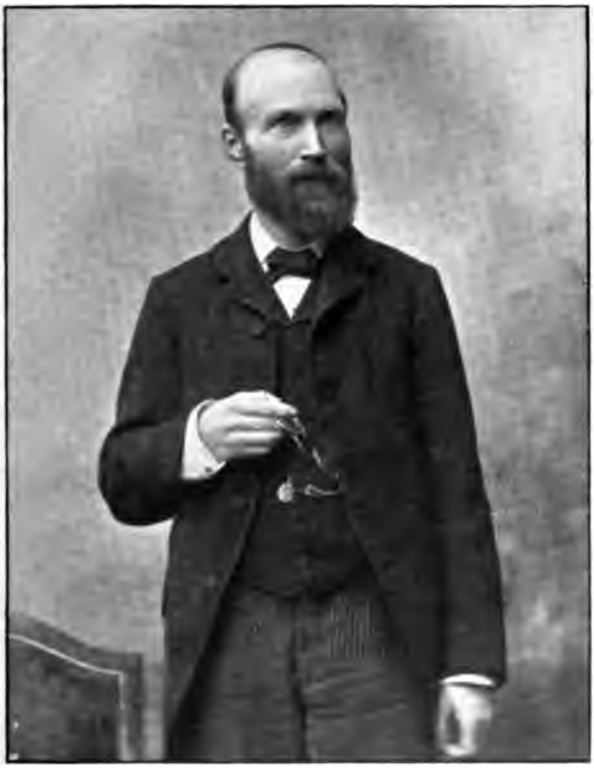
Dugald Bell, F.G.S.*

Mr. Bell was born in the Upper Ward of Lanarkshire in the year 1827, and so at the time of his death he had passed the allotted span. But time had laid his hand so lightly on him till recently, and he carried his spare but wiry figure so well that no one who saw him in his later years, entering heart and soul into some keenly discussed point, would have credited him with more than five decades.

When he was about a year old his parents removed to the Vale of Leven, Dumbartonshire, where the days of his childhood and schooltime were passed, and, consequently, the locality ever afterwards occupied a warm corner in his heart.

At a comparatively early age he began work in the office of the Dalmonach Printworks, one of the large industrial establishments which give the Vale of Leven its busy importance, and after some years was promoted to the post of cashier of the works. Still later he was translated to Glasgow, where in the town office of the same firm he held the important post of cashier.

Mr. Bell next received the appointment of confidential clerk to the well-known James Nicol Fleming, of City



Dugald Bell, F.G.S.

of Glasgow Bank fame, and on two occasions visited India on his affairs.

When Mr. Fleming's business was wound up Mr. Bell rested for a time from active work, and then accepted the post of cashier to the important firm of Messrs. J. & W. Campbell & Co., which post of responsibility he held with much acceptance to his employers until the final breakdown of his health towards the end of 1896.

Early in the sixties Mr. Bell married Miss Helen Inglis Bell, no relation of his own, by the way, but a daughter of Mr. James Bell, an esteemed master letterpress printer of the city, and a niece of her husband's old employer, Mr. James Scott of Dalmonach and Kelly. Their family consisted of two sons and two daughters, one of the latter having, to his lasting sorrow, predeceased her father.

When resident in the Vale of Leven Mr. Bell took a deep interest in the work of the Mechanics' Institute there, with which he afterwards kept up his connection by occasionally coming from Glasgow to lecture, principally on literary subjects. Here he had also developed a strong poetic bent, and even published a small volume of his collected pieces, but of this I have not been able to obtain any further particulars.

The faculty remained with him ever after, and our older members will doubtless recall to mind that after excursions, when passing from labour to refreshment, he would say, or even sing, some quaint and witty descriptive piece of verse, with pawky hits at prominent members. Many of his literary and scientific papers show his command of pure nervous English, but I am informed that he had not a facile pen in actual composition. His large acquaintance with books and his retentive memory served him well, however, so that when occasion required he could quote from many an author, or cap the lines or verses given by others.

Mr. Bell was a devoted member of the Free Church of Scotland in religion, and a strong Liberal in politics, though he never obtruded his views regarding either in

general company. After his migration to Glasgow he joined, in 1864, the Free College Church, where he became a deacon in 1867 and an elder in 1874. In this connection he was a pillar of the church literary society and a Sunday school teacher, and he often spoke at the congregational and mission meetings. He was a regular contributor of both prose and poetry to the church local supplement of the *Free Church Record*, but these, so far as I have seen them, are all on religious topics.

And now as to our deceased friend's more immediate connection with our Society and ourselves. He joined the Geological Society of Glasgow in 1860, two years or thereby after its formation, probably through his connection with Free St. Peter's Church, in the literary society connected with which this Society, as you may remember, took its rise and passed through its initiatory stages.

So far as the printed *Proceedings* of these early days go, we do not find that Mr. Bell took any prominent part in the Society's work, but he was elected a Member of Council in 1868 (4th October), a post which he held for several terms afterwards. On 9th April, 1870, his first printed paper was read, "Aspects of Clydesdale during the Glacial Epoch," and from this, so far as given in abstract in the *Transactions* (vol. iv., p. 63), it is evident that the theory of land ice being the origin of boulder clay was even then dear to him. But it is noteworthy that he also allows "a period of depression during which all but the higher mountains were submerged," an admission considerably at variance with his later standpoint on the same question.

On 6th October, 1870, he was made Joint Secretary with Mr. John Burns, after the resignation of the late Mr. James Armstrong, and held the position latterly of Corresponding Secretary, until 1875, when he resigned on the eve of his departure for India.

In 1872 he took a leading part in the discussions which arose regarding the glacial deposits of Renfrewshire and

North Ayrshire, which had then come much into evidence owing to the formation of a new railway between Crofthead and Kilmarnock, which caused extensive cuttings near Cowdenglen, in Renfrewshire, through deep deposits of boulder clay. The keenness of the controversy at this time is evidenced by the fact that no less than four pages of criticism by Mr. Bell are appended to a single paper by Mr. Robert Craig on the subject.

During the succeeding years various papers on local geological subjects and various notes on specimens were contributed by Mr. Bell, and in January of 1875 he read a paper "On the Geology of Switzerland," the outcome of a holiday he had spent in that country during the previous summer, and when, of course, he had paid great attention to the glacial conditions. At the end of 1875 the "Annual Report" states that, "owing to his business engagements calling him to India, your active and energetic Secretary, Mr. Dugald Bell, resigned his post about the end of the session, and, though at first intended to be only temporary, he has since written to say that his resignation must be considered as final."

A year later—7th December, 1876—it is recorded that "Mr. Bell, late Secretary of the Society, expressed his gratification at being present at a meeting, and seeing so many of the well-known faces, and at hearing evidence that the cause they all had at heart was progressing so favourably." He further remarked that his work in the Society had been of use to him in India, and he gave a few interesting particulars regarding the districts he had visited there.

On 10th November, 1881, he was elected one of the Vice-Presidents of the Society, a post he afterwards held on two occasions, and each for the full term of three years.

From this date onwards Mr. Bell contributed numerous papers to the *Transactions*, some on the general geology of certain districts, but more upon his favourite subject of glacial geology, the one in which, as most of us may remember, he always evinced the keenest interest, holding

himself ready always to do battle for his pet theory, the cause of land ice against that of submergence.

All of us know and have profited by the interesting and well-written volume published by Mr. Bell on West of Scotland Geology, "Among the Rocks round Glasgow," which was really the outcome of descriptive accounts of excursions taken by members of this Society in previous years. Its contents show more clearly than anything I can say what a clear and intelligent grasp he had of his subject, and how well he could express himself in clear, terse English.

For a good many years past Mr. Bell took a great interest in the annual meetings of the British Association, which he usually made a point of attending, so far as practicable. About ten years ago he was appointed secretary of one of the Association committees—that for the investigation of high-level shell beds—and took the leading share in its subsequent work at Chapelhall, in Lanarkshire; Clava, in Inverness-shire; and Tangye Glen, in Argyllshire. His last public appearance in this capacity was at the Liverpool meeting of September, 1896, when he bravely came down to read the committee's exhaustive report on the work amongst the high-level deposits at the last-named locality, Tangye Glen, near Campbeltown, Argyllshire. He had spent several of the previous days in bed, and it was only too evident to his friends that his strength was sorely sapped, and that only his indomitable spirit bore him up for the occasion.

On returning home he struggled on for a short time, but it soon became evident even to himself that he must give up the fight. His long subsequent illness was borne with patience and resignation, till by slow but sure degrees the enemy sapped all the defences, and he became helpless as the veriest infant. Indeed, as Mrs. Bell has informed me, for at least six months before the end came only the constant and devoted care of his daughter kept the frail body in life.

Wonderful to say, he retained his mental faculties till

within a few days of the close, and nearly all the weary time he seemed to be free from bodily pain.

D. C. Glen, F.G.S.,

was born at Hawkhead, near Paisley, on 12th January, 1824. He first went to school at Paisley, and afterwards to the Grammar School (High School) of Glasgow. His mind turning to engineering pursuits, he was apprenticed at the works of Charles Randolph, the predecessor of the well-known Randolph, Elder & Co., of shipbuilding fame. When his time was out here he went to Napier's engineering shop, afterwards being employed in charge of works at Airdrie and Dunfermline. About 1854 he started business for himself in Glasgow, in partnership with Mr. Richard G. Ross, the firm being Glen & Ross. Mr. Glen was also a partner in an iron pipe-founding business, and through these and his investments he amassed a considerable fortune.

Though thus actively engaged in business, he found time for satisfying his scientific tastes, and became more or less interested in most of the Glasgow scientific societies—the Geological Society, the Natural History Society, the Archæological Society, the Society of Engineers and Shipbuilders, and latterly, in 1876, the Geological Society of London.

Of our Society he became a member in 1866 and a life member in 1881, acting in many separate sessions as member of Council, and several times as Vice-President. He at various times contributed papers to the *Transactions*, and times without number brought for exhibition specimens of great interest and value. His special hobby was mineralogy, and in its pursuit he formed a large and fine collection, comprising many thousands of specimens from all parts of the world. His collection also embraced many fine palæontological forms. These he was always proud to show to any one interested, and for many years

gatherings of friends and members of the Society met at his house to inspect his treasures, as well as to partake of his ample cheer. From these it was difficult to tear one's self away until the small hours of the morning, there was so much to see and to hear.

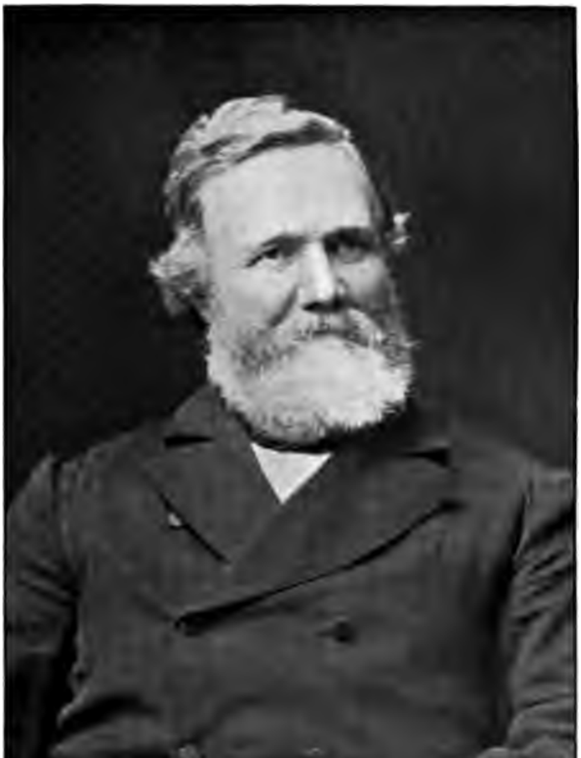
Mr. Glen was a considerable book buyer, more especially of works relating to the natural sciences, and most of the Glasgow book sales of later days saw him present either as buyer or observer. He had also a fancy for coins and medals and other antiquities, his collections of these, especially of bronze and silver medals, being of considerable interest and value.

In the excursions of the Society Mr. Glen took a special interest, and for many years very seldom one came off without seeing his portly, genial presence. His collecting bag was usually filled to the lip, and many a heavy burden he carried home, to be afterwards arranged, exchanged, or given away.

On many different occasions he acted as delegate from this Society to the British Association meetings, usually on his return giving an account of the district where the special meeting was held and of the excursions, &c., to the geological features of the neighbourhood.

Mr. Glen did not take part in municipal or in political affairs to any great extent, but served on the management of various charitable or educational bodies. For a term he was Deacon-Convener of the Trades' House, a member of committee of Hutchesons' Hospital, and a trustee of Anderson's College. When the East-End Exhibition was proposed, he became one of the Executive Committee, and actively promoted its interests to the close. A large portion of his mineralogical collection was shown at this Exhibition, but was so unfortunately housed that it did not attract half the attention which it deserved.

Mr. Glen amassed a magnificent collection of minerals, and these, together with his fossils, were acquired by the Corporation of Glasgow, and are now in the Museum at Kelvingrove.



David Corse Glen, F.G.S.

Biographical Notices.

James Barclay Murdoch.

Mr. Murdoch, Honorary Secretary of the Society for over thirty years, was born at Broadmarsh, near Hobart Town, in Tasmania, on the 4th of June, 1831. He was the son of Peter Murdoch, a Scottish officer in the army, who fought at Waterloo, and whose medal commemorative of that battle is still preserved in the family. In retiring from active service, his father sailed for Tasmania, as Aide-de-Camp to Sir Thomas M'Dougal Brisbane; and thus his son, James Barclay, came to be born abroad. His middle name, Barclay, bears testimony to the fact of his not distant connection with the famous family of the Barclays of Urie, in Kincardineshire, near Stonehaven; and it was borne by his mother, Barclay Brown, whose forefathers had long possessed the estate of Capelrig, near the Mearns, which he ultimately inherited. His mother's ancestors were nearly related to the Wallaces of Elderslie; so that he inherited the grand courage and sweetness of the great race of the Hero of the War of Independence, well represented midway by Provost Murdoch, of Glasgow, who ruled the city in 1745-6, during the inroad of the brave but brainless and bonny Prince Charlie!* James was seven years of age when his father returned to Scotland, where he ultimately purchased the estate of Langtemple, in Newton Mearns, not far from Capelrig, after residence in various parts of the country.

His son James was educated privately, at Ayr Academy, famous for its scholarship; and at the old College in the High Street, Glasgow, towards which he retained a life-long affection, and of which he had pleasant memories. He was intended for business, and, along with his father and friends, entered a firm of sugar refiners, &c., at Port-Dundas, which had various vicissitudes, during which he resided in the city.

He was twice married, first in 1858, at the age of

* See the newspapers of the time.

[illegible] en, to Margaret Emily Morris, daughter of [illegible] Morris of Moorburn, Largs. She died in 1863, [illegible] e short years of wedded life; leaving two sons, [illegible] st now in South America, and one daughter. In 1865 he married Jane Helen Morin Wilson, daughter of Mr. John Wilson of Hillpark, Bannockburn, who still, happily, survives him, after more than forty years of happiest union as wife and friend, companion and sympathiser, in all his studies and tastes.

In 1884 he [illegible] the estate of Capelrig, inherited from [illegible] ary Brown; and there he resided for mor [illegible] ears—until his death—in rural ease and comfort, [illegible] ideal country residence, amidst beautiful scenery; [illegible] all the amenities of wild and cultivated nature, and with in easy access to the city, in which were centred his varied scientific and literary activities, during a long and happy life.

From the first, Mr. Murdoch was interested in intellectual pursuits, to which he devoted himself while carrying on business; and, from an early date, joined many Societies, to supply food for these higher appetites, connected chiefly with Science, Archæology, and Literature.

Of the many subjects he studied, none attracted him more than Geology. He joined our Society in or before the year 1858-59; so that, at his death, he was a long way the oldest surviving member. He became Honorary Secretary in 1876, when Mr. Dugald Bell retired from that office, after long and distinguished service. Mr. Murdoch was thus our Recorder of events for thirty years; and the Society never possessed a more enthusiastic, hard-working, and devoted servant.

As a Geological student, his tastes and studies did not lead him towards its more severely scientific and practical aspects, like those of his friend Dr. John Young. He thus made no contributions to its fossil lore, like Young and others of his intimates, in which our Society has done such distinguished work. He was more attracted by its general

James Barclay Murdoch.

and philosophic side; and especially by that interesting and fascinating borderland, where it touches and interprets the early developments of humanity, and its far-reaching relations to many human problems of profoundest importance. He kept himself, throughout life, fully abreast of its ever-expanding literature; no easy task, as its more earnest students are the first to confess. It thus appears that his contributions to the *Transactions* are comparatively few. These include "Journal of a Bore put down for Water at Thornliebank, Renfrewshire"; "Notes on a Visit to the Culbin Sands, Morayshire"; and "Notes on some of the Principal Papers at the British Association Meeting, Aberdeen, 1885"; read at different dates. His oral additions at our gatherings were always interesting.

For many years he was a member of the British Association, and gave interesting reports to the Society of the meetings, which he made a point of attending with great regularity. Of these, however, only short abstracts have been preserved in the *Transactions*. His chief contributions to our meetings were Obituary Notices of departed members, of which he wrote more than one.

These Notices were characterised by a pleasant style, kindly insight into character, fair criticism and generous appreciation of work done; and, including those he wrote for other Societies, by singularly sympathetic relations with a wider range of men and manners than is common. He wielded a facile and felicitous pen, with a gracious garrulity, the fruit of countless personal memories, happily and unpolemically expressed, without a touch of scorn, one grain of spleen, or shade of envy.

In September, 1901, the annual meeting of the British Association was held in Glasgow. A committee was appointed to draw up handbooks for the use of the members; and valuable memoirs were compiled by the best authorities. The handbook on the Fauna, Flora, and Geology was edited by Mr. Murdoch, Dr. Malcolm Laurie, and Mr. G. F. Scott Elliot, and was of eminent value on

the different subjects, the articles being written by the best-informed authors on each.

Another department of Science to which he devoted himself all his life was Natural History; and he became an active member of the Natural History Society of Glasgow, which he joined in 1851, a connection which included thirty-six years' active co-operation, and continued till 1887.

He was a Member of Council for five years, from 1871 to 1876, and again for other five years, from 1879 to 1883, while from 1876 to 1879 he held the office of Vice-President. He had a general knowledge of the many subjects treated by the Society, and took a living interest in its labours and a regular part in its discussions, but he contributed few papers to its *Transactions*.

But these sparse records are no index of the services he did the Society, of which he was an energetic and enthusiastic member during his whole connection with it.

Mr. Murdoch was also a Fellow of the Royal Physical Society of Edinburgh, to which he was elected in 1882.

Mr. Murdoch for a number of years acted as Chairman of the Justices of the Peace; and at Quarter Sessions (although not a teetotaler) his influence and his vote were always on the side of temperance.

He was also an enthusiastic Archæologist, and was widely read in its various interesting fields. He became a member of the Glasgow Archæological Society at its resuscitation in 1877, and was for many years an active Member of Council. In 1890 a Committee, of which Mr. William Jolly was convener, was appointed by the Society to make investigations into the Antonine Wall, which runs across what is known as the Northern Isthmus between the Forth and the Clyde, the great turf rampart erected by Antoninus Pius in A.D. 140.

Many a happy hour did we spend in that congenial work, under the healthiest and happiest conditions, encouraged from time to time by discoveries that revolutionised former conclusions in regard to the structure. These have exceeded all expectations and created quite

a new era on the whole subject of Roman history and policy in Britain. In this very fascinating subject Mr. Murdoch kept up his interest to the last, and watched with keenest expectation every new discovery.

He was long a Fellow of the Antiquarian Society of Edinburgh, joining in 1879, and remaining in connection with it till 1893; contributing only one paper to its *Transactions*, "A Note on a Stone Celt found on the Estate of Naemoor, Muckart, Kinross."

Next to the Geological Society, there was no local institution in which our friend took greater interest than the Stirling's and Glasgow Public Library. He joined it in 1883, and remained an active member until his death. There Mr. Murdoch was quite in his element, and brought to bear on its affairs his wide knowledge of books, to the immense advantage of the Library.

The Centenary of its foundation, in 1891, was an important occasion in its history, and was celebrated by a great meeting held in the Banqueting Hall of the City Chambers, before a distinguished company. For that celebration, a delightful account of the Library was prepared by Mr. Murdoch, under the title, "Stirling's and Glasgow Public Library: Its Story from the Minute Books"; a subject quite to his liking, of which he made the happiest use.

Capelrig, the home of our departed friend, is a delightful, simple, old-fashioned house, an ideal country mansion, nestling amidst undulating pastoral fields and woodland clumps on the healthy uplands beyond Giffnock, sloping onwards to the Mearns; cherished by its late owner, the haunt of many memories, and the home of culture and refinement. For a man of his tastes, it stands also in the centre of an interesting Geological area, connected with the Giffnock Sandstone and the Arden and Orchard Limestones. Its interior was crammed with books and pictures, curios and engravings; the inheritance of a long ancestry, and redolent, in every corner, of the tastes of himself and his forefathers.

Paintings of these and other friends gazed on us from every nook; exquisite old plates graced the spaces between; rare old china, carved weapons of war and peace, crowded cunning corners: so that not an inch of space was left uncovered with riches in Art, Literature, Science, and Archæology that were the envy of the connoisseur.

As for books, they were everywhere, in single and double rows, from floor to ceiling, in hall, room, and bedchamber; many in various old bindings, hundreds of special value, in rare editions and on curious and varied subjects—all revealing the broad tastes and many studies of their departed master, as well as the likings of his predecessors. Learning, culture, and taste, science, literature and art, were revealed at every turn. But, with all these crowded restraints, homeliness, cosiness, and comfort pervaded every room, breathed from every smile of the kindly host and hostess, and radiated from every movement, from hearty welcome to kindly farewell. It was a rare privilege to have access to such a dwelling-place of peace and plenty, costliness and culture; as all have felt that have, at any time, enjoyed its genuine, unobtrusive, and informal hospitalities.

Mr. Murdoch's library was one of the outstanding libraries of Glasgow, and was described in detail in that valuable work, "Glasgow Public and Private Libraries," written by Mr. Thomas Mason, keeper of Stirling's Library. It is there rightly characterised as "taking honourable rank among the libraries of the district, and as well known as larger collections." There Mr. Murdoch is himself described as "probably one of the most familiar figures in local literary and scientific circles. His library," Mr. Mason well observes, "was a reflex of his needs and studies, and was, therefore, an eminently practical collection. In 1885 it numbered between four and five thousand volumes, and was subsequently increased in numbers, value, and interest." Our friend was an ardent student of Burns, and had collected a large

number of valuable books on the subject, as well as several noteworthy original MSS. and early editions, described by Mr. Mason, which fetched large prices at the subsequent sale. After a full account of the chief treasures of the library, Mr. Mason concludes by saying that, "take it all in all, this was a many-sided collection of high practical and monetary value."

Very few people have any idea of the care which Mr. Murdoch exercised over our *Transactions*. It was the hobby of his life. Not content with merely slight corrections, he actually re-wrote many of these papers. So that in literary style our *Transactions* are second to none; the same might be said of their scientific value, although for this the authors themselves are responsible.

Mr. Murdoch is also the author of that extensive part of our *Transactions* known as *Proceedings*, which, if collected together, would amount to several volumes.

Capelrig witnessed an impressive sight on the 25th of May, 1906, when a great company of attached friends assembled to join in the last obsequies to the departed Laird of the Land, and to accompany his dust, in a long cortege, to the tomb of his ancestors, under the spires of of our grand Cathedral.

ANDREW PATTON.*

Mr. Andrew Patton was born of humble parentage in the county of Northumberland, near famous Flodden Field, in the year 1821; and, as might have been expected, he was sent at an early age to work in the colliery where his father was employed. His chances of schooling were thus very limited; but he soon began a system of self-culture which grew with his growth and continued literally to the end of his life.

Entering into the bonds of matrimony as a young man,

*From a paper contributed to the Society by Mr. James Coutts, and printed in the *Transactions*, vol. viii., p. 171.

Mr. Patton came to Scotland, and obtained work at several collieries in Ayrshire and Renfrewshire, settling down eventually about the year 1858 as manager of the Calderwood Cement Works, in East Kilbride, and this situation he held for nearly a quarter of a century, until, indeed, the failure of Messrs. John Brown & Co., the lessees of the workings, which were then closed.

Having not only a practical but a theoretical experience of mining operations, Mr. Patton was soon found by both masters and men to be a thoroughly reliable and competent manager, while his calmness and self-possession in times of emergency or danger were of infinite service in keeping the works free from accidents. Indeed, his reputation extended so widely that he received various tempting offers from coal and iron masters to change employment, but his affection for East Kilbride, where his early married life had been spent, and in the churchyard of which more than one of his children had been laid to rest, prevented him from accepting any of them, however advantageous they seemed to be from a worldly point of view.

At an early period Mr. Patton began to interest himself in the fossil remains found in the strata amongst which much of his time was passed, and he soon became an ardent and skilful collector. By degrees the richness of his collection became known to palæontologists, and frequent visitors began to find their way to East Kilbride. To these he was only too liberal in the bestowal of specimens, and few left his house without some tangible memento of their visit. Specimens of the rarer and undescribed forms were coveted by the authorities of the public museums, and were on different occasions acquired by the Museum of Science and Art in Edinburgh, by the British Museum, and by others. From first to last the number of species added to the lists by Mr. Patton's instrumentality must have been considerable, while some of his discoveries still remain undescribed. One of the most notable of his finds was the fine specimen of *Psephodus magnus*, Ag., which has been lately figured and described

by Dr. R. H. Traquair in our *Transactions*. (See vol. vii., pt. 2, page 392.)

In 1876 Mr. Patton sent to Glasgow, for exhibition at the Corporation Galleries during the meeting of the British Association, a small but extremely interesting case of fossils from the cement limestones, which attracted a considerable amount of attention. It was afterwards sent on loan to the Greenock Museum, where it remained till a quite recent date.

In 1880 he was, as a mark of respect, elected a Corresponding Member of this Society, an honour upon which he placed high value, and in the session of 1883-84 he contributed an interesting paper upon the geology of his district, accompanied by sections drawn to scale, which showed his ability as a self-taught artist. To this paper I had the pleasure of appending a list of the fossils found in the East Kilbride district, the details being, of course, to a considerable extent supplied by Mr. Patton himself. (See vol. vii., pt. 2, page 309.) The *Phyllopoda* in the list appended to Mr. Patton's paper were described by Mr. Etheridge, jun., and Mr. Woodward in the *Geological Magazine* for 1872-73; *Palæsquilla Pattoni*, by Mr. Peach; and *Fissodus Pattoni*, by Mr. Etheridge, jun.

In addition to his ordinary work and his scientific pursuits, Mr. Patton took a great interest in matters relating to the social well-being of the district, the great success of the local Co-operative Society being due largely to the assistance he afforded it in its early days. He was, above all, of a most kind-hearted and simple-minded disposition, but so retiring and unobtrusive in all his actions that of him it might truly have been said, in the words of Goldsmith, "He did good by stealth, and blushed to find it fame." Mr. Patton died on the 23rd July, 1885.

John George Goodchild, F.G.S.,

was born near London in the year 1844, and was thus at the time of his death in his sixty-second year. He joined

the English Geological Survey in 1867, and for a number of years was engaged in mapping areas in the North of England, and more especially in the Lake District.

From there he went to the headquarters of the Geological Survey at the offices in Jermyn Street, London, till, in 1887, he was transferred to the Scottish Survey, and came to Edinburgh, where he was placed in charge of the rock and mineral collections, accumulated by the officers of the Scottish staff, and deposited in a wing of the Royal Scottish Museum, then the Museum of Science and Art, Edinburgh, a post he was eminently qualified for.

In recent years he had also placed under his care the Scottish mineral collection belonging to the Museum, and this led him to devote much time to the special study of mineralogy, which he afterwards turned to account by editing the important work on Scottish mineralogy by the late Professor Heddle, which had been left, owing to its author's death, in an incomplete state.

The preparation of this important work for publication, consisting, as it did, of between 400 and 500 royal 8vo pages of letterpress and over 100 plates, each containing a number of figures of crystals of Scottish minerals, involved an extraordinary amount of time and work on the editor's part, and even may have had something to do with affecting Mr. Goodchild's health.

But at no time could he be idle or unemployed, and if not at work in the Museum, he was teaching student classes, lecturing at the Heriot-Watt College or elsewhere on physical geography, geology, or palæontology, or acting as conductor of the excursions of the various scientific societies in Edinburgh and other places. In this latter connection many of our members must remember frequent pleasant days when the deceased gentleman led them over attractive geological fields, and opened out to them the abundant stores of his knowledge.

Besides all this work, with a wide range of mind and a facile pen, Mr. Goodchild contributed an extraordinary

number of papers—said to be over two hundred—to the *Transactions* and *Proceedings* of various scientific societies in Scotland and England, including our own. In recognition of his labours in the geological world, the Geological Society of London awarded Mr. Goodchild the balance of the Wollaston Donation Fund in 1874.

His versatile gifts were further shown by his keen interest in other branches of science, his knowledge of botany and ornithology being considerable. All these varied qualifications made him a valuable conductor of field excursions and an exponent of geological problems among numerous scientific societies. His restless mental and bodily energy, reacting on a constitution never very robust, may be said to have shortened his career. Mr. Goodchild died in Edinburgh on the 21st February, 1906.

David Page, LL.D., F.G.S.

The subject of this notice was born on the 24th August, 1814, at Lochgelly, in Fifeshire, his father being in the building trade. He received his early education at the parochial school, and at fourteen years of age entered the University of St. Andrews. In the year 1834, when he had just left the University, he published an essay on the geology of Fife and Kinross. Dr. Page was engaged in 1843 to act as confidential, literary, and business adviser to Messrs. Chambers, the well-known publishers, of Edinburgh. Shortly after he entered the service of this firm his earliest text-book on geology appeared under the title of "Rudiments of Geology," and from that time till his death he wrote a large number of books dealing both with the popular and educational aspect of the science. He was appointed in 1871 Professor of Geology in the Durham College of Physical Science at Newcastle-upon-Tyne, which post he retained till his death. During the early period of our Society's history Dr. Page delivered year after year a course of lectures

upon some geological subject. The charm of his style, the originality and wide scope of his views, and his power of reproducing abstract science in popular language and of investing it with a living interest roused the attention and enlisted the sympathies of all classes of the community. At every successive course of lectures in the Merchants' Hall, then in Hutcheson Street—at that time the principal hall in the city for such gatherings—there was an increase in the attendance of the *élite* of the intellect of Glasgow; while with it came an increase to the popularity of the Society and a corresponding addition to the membership. When Dr. Page left Glasgow he was invited to a farewell entertainment by a number of friends, which included many members of the Glasgow Geological Society. He died at Newcastle-on-Tyne on Sunday, 9th March, 1879, in his sixty-fifth year.

Chapter XII.

The Present Position of the Society.

In the preceding chapters an account has been given of the more important aspects of the Society's work during the last fifty years. Not without profit may we next briefly consider how we stand at present, and what may be our outlook for the future. Good work has been done, and will be done again, yet no one but an incurable optimist could maintain that, in every respect, the position of the Society is as satisfactory as it might be. During the last forty years the population of Glasgow has grown from 470,000 to nearly 800,000. Forty years ago the members of the Glasgow Geological Society numbered 231, while to-day the total is 228. This seems strange in a city whose existence is so closely bound up with mining enterprises of various kinds. The remedy lies largely in the hands of each member of the Society. Even in this respect, however, signs of an awakening are not absent. The new School of Geology in the University, with its own Society, is yearly turning out numbers of students, many of whom, on finishing their University course, will naturally gravitate towards the city Society. The Technical College is doing good work in the same way. These recruits, too, are of the type most desired, young and anxious for research, their enthusiasm tempered by sound training. Their original work should find a natural channel for publication in our *Transactions*.

In most sciences the day of the amateur has departed. Palæontologists tell us that the great mammals of Tertiary times disappeared through over-specialisation. In many branches of geology the amateur, at any rate

as a large contributor of original work, is being hurried to extinction by the same cause. Yet there will always remain problems of local geology, for the solution of which a highly technical training is unnecessary, for which the best qualifications are a keen eye, patient observation, and sound judgment. That the work done by the Society is not diminishing is demonstrated by the *Transactions*. For the past three years a precedent has been established by publishing each session's work at the beginning of the next official year. The opportunity of early publication thus afforded to authors should attract to our *Transactions* the best work done on this district, and that these opportunities are being appreciated is shown by the important paper contributed by Messrs. Carruthers and Anderson, of the Scottish Geological Survey, to Part 2 of the current volume of the *Transactions*.

Fortunately, several of the most distinguished workers in the early years of our Society are still with us, and it seems appropriate here to give a short account of some of them.

Sir Archibald Geikie, K.C.B., P.R.S., &c., Honorary Member, 1863; President, 1893-1896.

The roll of Presidents of the Geological Society for the West of Scotland would have been woefully incomplete had it not included Sir Archibald Geikie. For, though he was born and educated in Edinburgh, and his two chief Scottish appointments were held in that city, he has made most important contributions to the geology of the Glasgow area, and many passages in his "Reminiscences" and in his "Scenery of Scotland" suggest that the western lochs and islands hold his deepest attachments. That he may be regarded as belonging to Western Scotland by geological and geographical sympathy may be inferred from his fondness for its

Sir Archibald Geikie, P.R.S.

scenery which he has so eloquently described and interpreted with unequalled insight.

Sir Archibald Geikie was born in Edinburgh on the 28th December, 1835. He was the eldest son of James Stuart Geikie, his younger brother being Professor James Geikie. He was educated at the Edinburgh High School and University, and a charming essay on his first geological excursion shows that his interests in geology were early roused. His original geological work was begun in the Island of Arran, and was described in some articles that attracted the attention of Hugh Miller, by whose influence Geikie was appointed at the end of his University course and at the age of twenty to the Geological Survey of Scotland. Most of his official surveys were in the southern Uplands, Ayrshire, and the neighbourhood of Glasgow. His intimate personal knowledge of our area enabled him to draw from it many striking illustrations in his text-book and in his monumental work on "The Ancient Volcanoes of the British Isles." His name is familiar to us at the foot of several of the maps of the Glasgow district. His researches were by no means confined to the area of his official duties. He explored the Western Highlands and Islands, especially studying their extinct volcanoes and the Old Red Sandstone. He accompanied Sir Roderick Murchison in some of his Scottish journeys, and in 1861 was associated as joint author in two of Murchison's most famous Scottish papers, those on "The Coincidence of Stratification and Foliation" in the rocks of the Durness-Eriboll area, and on "The Sequence of Rocks in the South-western Highlands in comparison with that of the Grampians."

In 1871 Sir Archibald Geikie was appointed Murchison Professor of Geology and Mineralogy at the University of Edinburgh, and in the same year he married a daughter of Mons. Pignatel, of Lyons. He had meanwhile, in 1867, been appointed Director of the Geological Survey for Scotland, and, after the retirement of Sir Andrew Ramsay in 1882, was naturally selected as Director-

General of the Geological Survey of Great Britain and Ireland. He promptly began energetic and needed reforms. He secured the removal of some members of the staff whose work had been unsatisfactory, and attracted to it some of the most promising British geologists. On his retirement in 1901 it was universally recognised that he had greatly raised the status of the Survey, and secured its permanent establishment.

In 1903 his administrative ability found fresh scope as secretary of the Royal Society, and he has recently been elected its president. In 1906-7 he received the high compliment—especially significant as it came from the most expert body of geologists in the British Isles—of re-election as President of the Geological Society for a second term of office, so that he might preside at the Centenary of the Society. He had been President of the Society in 1891 and 1892, and President of the British Association at Edinburgh in 1892. The wide range of his work and influence naturally secured widespread recognition; he has received honorary degrees from all four Scotch Universities, and from Oxford, Cambridge, and Dublin; he is an honorary correspondent of the chief foreign scientific Academies, including the Institutes of France and Rome, the Academies of Belgium, Berlin, Christiania, Göttingen, Munich, New York, Philadelphia, Stockholm, Turin, Vienna. He has received the chief medals at the disposal of the Geological Society, the Royal Society, the Royal Society of Edinburgh, and others from foreign societies and Academies.

Sir Archibald Geikie's connection with the Society dates from 1862, when he read his important memoir "On the Phenomena of the Glacial Drift of Scotland," which occupies the second and larger part of the first volume of our *Transactions*. He is the senior honorary member of the Society, having been elected early in 1863. He was President from 1893 to 1896, and gave to the Society as his presidential address a graphic history of "The Latest Volcanoes of the British Isles."

The Present Position of the Society.

It is impossible in a brief notice even to mention the various branches of geology and geography which Sir Archibald Geikie has advanced, and it would be unfitting to estimate the value of his work while it is still in progress. His writings are voluminous, and they are always original and suggestive. He has written more books than any other living British geologist, and his work covers an unusually wide range; his best-known researches are connected with physical geology, especially with denudation, glaciation, and volcanic action, with the formation of the Old Red Sandstone and the evolution of scenery; in a book which should be in every Scotchman's library he has followed Scottish scenery back to its geological causes, and in some illuminating essays he has traced the psychological influences of geographical conditions and landscape upon the character and literature of the British race.

The following papers by Sir Archibald Geikie have been published in the Society's *Transactions*:—

"On the Phenomena of the Glacial Drift of Scotland." *Trans. Geol. Soc., Glasgow*, vol. i., part ii., 1863, pp. 8-190. Map.

"Lecture on the Origin of the Present Scenery of Scotland." *Trans. Geol. Soc., Glasgow*, vol. ii., part i., 1865, pp. 4-12.

"On the Order of Succession among the Silurian Rocks of Scotland." *Trans. Geol. Soc., Glasgow*, vol. iii., part i., 1868, pp. 74-95.

"On Modern Denudation." *Ibid.*, pp. 153-190.

"The Latest Volcanoes of the British Isles." *Trans. Geol. Soc., Glasgow*, vol. x., part ii., 1896, pp. 179-197.

"Recent Researches into the History of the Deposits known as Old Red Sandstone." *Trans. Geol. Soc., Glasgow*, vol. v., part ii., pp. 276-281.

The Present Position of the Society.

Charles Lapworth, M.Sc., LL.D., F.R.S., F.G.S., President 1899-1902.

To a marked extent Professor Lapworth's work has been identified with Scotland. He taught as a schoolmaster for seventeen years, first in Galashiels, where he started his geological work, and then in Madras College, St. Andrews. His two greatest achievements were elucidations of Scottish geology, and rank among the most brilliant work ever done in the science. His first paper was read before the Geological Society of Edinburgh in 1870, and in 1873 appeared his paper "On an Improved Classification of the Rhabdophora," which revolutionised the study of graptolites. To quote from von Zittel's "History of Geology"—"All later writings on graptolites are based on the results obtained by Lapworth." He applied his work to the study of the southern Uplands of Scotland, and made his reputation as a stratigrapher by his masterly elucidation of the complicated Moffat district. His first contribution to our *Transactions* was a paper on this subject read in 1872 and published in 1874.

Lapworth was one of the protagonists in the great controversy regarding the structure of the North-west Highlands. Resting on the Hebridean gneiss of this district appears a series of conglomerates, sandstones, quartzites, and limestones containing Cambrian fossils in their highest beds. These beds are overlain to the east by metamorphic gneisses and schists, which in turn are covered by rocks of Old Red Sandstone age. Sir Roderick Murchison and Sir A. Geikie maintained that the apparent sequence was the true one, and the upper schists were therefore metamorphosed Silurian sediments. In 1859 Professor Nicol, of Aberdeen, asserted that the appearances were deceptive, and that the upper schists were really older rocks, brought up by a series of tremendous overthrusts. The simpler views of Murchison and Geikie were generally accepted, but in 1882 Professor Lapworth commenced to study in detail part of the region,

Charles Lapworth, LL.D., F.R.S.

and communicated his results in a most important series of papers. His researches led him to the conclusion, now completely demonstrated by the Survey, that Nicol was substantially correct, and that Murchison and his followers had failed to perceive the true structure of the ground.

These papers on the Highland area involved the discussion of the principles of mountain building, first enunciated in detail by Heim in his "Mechanismus der Gebirgsbildung," and in Lapworth's hands these principles have proved remarkably effective in the explication of complicated tectonic structures.

Even the briefest account of his work would be incomplete without a reference to the great influence of his personality on all who have been brought in contact with him, and the inspiration and stimulus to better work that they have never failed to receive therefrom. It is nearly twenty years since (1889) he received the greatest distinction the Geological Society of London has to offer—the Wollaston Medal. The following papers by Professor Lapworth have appeared in the *Transactions of the Geological Society of Glasgow*:—

"On the Silurian Rocks of the South of Scotland." Vol. iv., pp. 164-174.

"Recent Discoveries among the Silurians of South Scotland." Vol. vi., pp. 78-84.

"On Graptolites." (Abstract.) Vol. vi., pp. 260-261.

B. N. Peach, A.R.S.M., LL.D., F.R.S.,* President 1905-1908.

I was born on 6th September, 1842, at Gorran Haven, a fishing village about three miles from Mevagissey, on the south coast of Cornwall. It was while stationed

* The editors consider that the notice of Dr. Peach should be left in the autobiographical form in which it was furnished to them by our late President.

at Gorran Haven as an officer in the Coastguard that my father, the late Charles William Peach, discovered Lower Silurian fossils in the quartzites there that fixed the geological horizon of those rocks. My father having been transferred to H.M. Customs at Fowey, at the age of two I went with my parents to live at Fowey, a lovely place situated at the mouth of the Fowey River, a little further east than Gorran, and which has now become quite a fashionable resort. During the five years I lived there I sometimes accompanied my father and brothers while they were collecting fossils from the Devonian rocks, and can well remember two localities —one, Punches Cross, at the mouth of Fowey Harbour, which yielded compressed specimens of a trilobite, *Phacops*, and the casts of pretty little shells, which I now know to belong to the genus *Bellerophon*. I also remember a cove situated about half-way between Fowey and Looe, where fragments of fish were to be seen in the pebbles of lustrous phyllites that make up the beach. (These fish remains have been determined as belonging to *Pteraspis*.)

Being promoted to Peterhead in 1849, my father went there, leaving us (my mother and the family) at Fowey till the spring of 1850, when we joined him. At Peterhead I began the rudiments of my education at the Academy there. Another kind of education I got also, as I soon came to know the contents of nearly every rock-pool along the shore for miles. Among other things, I can remember the finding of the nests of the "Horsefish" (local name for the fifteen-spined stickleback), and frequently found the male "Paddle cock" (as the lump sucker, *Cyclopterus lumpus*, is called there) stuck to the rock beside the lump of spawn deposited by his consort. My father at this time took up the collecting of algæ very keenly, so that I became acquainted with the commoner species and some of the rarer ones. Under the guidance of Thomas Hutton, an employee of the Customs, who was a keen and expert boatman, fisherman, and

Benjamin N. Peach, LL.D., F.R.S.

cragsman, I was initiated into the secrets of the nesting places of sea fowl that frequent the rocky coast for some miles south of Buchan Ness, by Slains, Errol, and the Bullers of Buchan, and the Stack of Dunbuy. This is a favourite breeding station of innumerable gulls, guillemots, razorbills, puffins, and cormorants, as well as other birds. Under Hutton's care I soon developed a climbing head, and paid visits to the sitting birds on their ledges and in their burrows, and my fingers made practical acquaintance with the sharpness of the puffins' bills.

My wonder was powerfully excited by the fact that the granite, which is the prevailing rock at Peterhead, remained hard or only broke up into shingle on the exposed coast, while in the sheltered harbour I saw it being dug out with the spade when the harbour was being deepened, the disposition of the minerals in the soft mass plainly showing that the rock had rotted in place.

At the age of ten I left Peterhead and proceeded with my father and the rest to Wick, to which place he had been promoted. Here my education was continued at Wick Academy (founded by the "British Fisheries' Society"), and to the rector of the Academy, Patrick Smith, M.A., now deceased, I am indebted for a great deal more than mere book-learning. On the retirement of Mr. Smith I left school and went into a lawyer's office for a year, being too young to matriculate at the School of Mines, where my father, having been induced by Sir R. I. Murchison, resolved to send me with a view to my subsequent joining the Geological Survey.

Sir Roderick Murchison, at the time of his visits to Caithness on the occasion of my father's discovery of Lower Silurian fossils of American facies in the Durness limestone, had observed the keen interest I took in my father's hunting for material for studying the marine zoology of Caithness, and also the finding of fossil fishes from the Caithness flagstones.

I had also collected material from the broughs and "Picts' houses" near Wick, and was fortunate enough

to find a special type of weaving comb and some stone vessels now in the Antiquarian Museum, Edinburgh.

In 1859 I joined the Government School of Mines, then housed in the Museum of Practical Geology, 28 Jermyn Street, London, and came under the immediate influence and teaching of that brilliant band of illustrious men who then constituted the staff, viz., Sir R. I. Murchison, A. C. Ramsay, Huxley, Tyndall, Stokes, Hoffman, Warrington Smyth, Percy, and Salter, all now gone over to the majority, and of Sir A. Geikie, who afterwards became my chief while he was Director-General of the Geological Survey, and who, as President of the Royal Society, now holds the highest post to which a man of science can attain in our country.

My subsequent career is briefly sketched by my old colleague, Dr. John Horne, whose friendship has been one of the greatest acquisitions of my life.

[The next two paragraphs are taken from an article by Dr. Horne in the *Geological Magazine*, 1906.]

"In September last B. N. Peach, F.R.S., retired from the Geological Survey, after a period of forty-three years' service. Joining the staff in 1862 as assistant geologist, after a distinguished career at the Royal School of Mines, he was engaged for the first few months in determining Carboniferous fossils from the county of Fife under Salter's supervision in the London office.* When favourable opportunities presented themselves during his subsequent career, he pursued this branch of research with keen fascination, impelled by the instinct of the naturalist, which he inherited from his gifted father. In the same year he was attached to the field staff in Scotland, then under the direction of Sir Andrew Ramsay, and in 1867 he was appointed geologist when a separate staff was organised for the northern part of the kingdom, under the directorship of Sir Archibald Geikie. Throughout his long career it has fallen to his lot to take a prominent part in mapping all the palæozoic formations

*** 28 Jermyn Street. Museum of Practical Geology.**

in Scotland, together with large areas of crystalline schists of the Highlands. In particular, the detailed work in the complicated region in the West of Sutherland and Ross was carried out under his immediate supervision. It is within the mark to state that no other geologist has acquired such a thorough mastery of the details of Scottish geology, exclusive of the rocks of Secondary and Tertiary age.

"In 1879, after Mr. Etheridge, jun., had joined the geological department of the British Museum under Dr. H. Woodward, F.R.S., Dr. Peach, in addition to his field duties, was appointed Acting Palæontologist on the Scottish staff. He was thus furnished with opportunities which he had long in view. He devoted special attention to the palæozoic arthropoda, and, in addition to his purely official work, he published papers in the *Transactions of the Royal Society, Edinburgh; the Geological Society, London;* and the *Royal Physical Society, Edinburgh.* Among these papers we may particularly mention those dealing with the fossil scorpions of the Carboniferous and Silurian rocks of Scotland, and with the fauna of the *Olenellus* zone of the North-West Highlands. But the incessant demands of field work prevented him from carrying on his investigations as fully as he had hoped."

My retirement from the Geological Survey on 6th September, 1905, gave me the desired leisure, and I have been enabled to work at my favourite subject. On the 28th October of this year (1908) there has been published as one of the "Memoirs of the Geological Survey" a monograph on the Higher Crustacea of the Carboniferous Rocks of Scotland, in which I describe forty species and varieties of Schizopods, twenty-three of which are new. The monograph is illustrated by twelve plates of figures reproduced from my own drawings by the collotype process. For the purposes of the memoir, I have examined over 2000 specimens belonging to the Geological Survey, as well as other collections, having made use, among

others, of those made by our own fellows, viz., Mr. Dunlop and the late James Coutts, to each of whom I dedicate a species.

Among the published results of my Survey work may be mentioned my share in the "Monograph on the Silurian Rocks of the South of Scotland" and "General Memoirs, North-West Highlands."

I may say that I am prouder of my A.R.S.M. (Associate of the Royal School of Mines) than of any other of the distinctions that have been conferred on me.

B. N. P.

The contributions of Dr. Peach to our *Transactions* are as follows:—

"The Cambrian Fauna of the North-West Highlands." (Summary.) Vol. xii., p. 223.

"Notes on a Specimen of Glyptoscorpius from the Coal Measures of Airdrie." Vol. xiii., pp. 1-3.

RAMSAY HEATLEY TRAQUAIR, M.D., LL.D., F.R.S., PRESIDENT 1902-1905.

Dr. Traquair was born in 1840 at the Manse of Rhynd, Perthshire. He was educated at Edinburgh Institution and Edinburgh University, and graduated as Doctor of Medicine in 1862, obtaining a gold medal for his graduation thesis. Much of Dr. Traquair's later success in palæontological investigations may be attributed to his early training in anatomy, in which subject he was Demonstrator for three years in Edinburgh University. He obtained the Chair of Natural History in the Royal Agricultural College, Cirencester, in 1866, but the following year left to become Professor of Zoology in the Royal College of Science, Dublin. In 1873 he became Keeper of the Natural History Department in the Royal Scottish Museum, Edinburgh, from which post he retired in 1906, after having held it for thirty-three years. For two

Ramsay H. Traquair, M.D., F.R.S.

periods during that time, namely, from 1883-1887, and again from 1896-1900, Dr. Traquair was appointed to deliver the Swiney Lectures in Geology at the British Museum, London.

His original work comprises over one hundred papers on zoological and palæontological subjects, principally dealing with palæozoic ichthyology. A few of the memoirs embodying his more important researches are as follows:—

"The Asymmetry of the Pleuronectidæ." *Trans. Linn. Soc.*, 1865.

"The Structure and Systematic Position of the Palæoniscidæ." *Palæontographical Society of London*, 1877.

"The Structure and Affinities of the Platysomidæ." *Trans. Roy. Soc., Edin.*, 1879.

"The Silurian Fishes of Scotland." *Trans. Roy. Soc., Edin.*, 1899, with Supp., 1905.

"On the Distribution of Fossil Fish Remains in the Carboniferous Rocks of the Edinburgh District." *Trans. Roy. Soc., Edin.*, 1903.

"The Lower Devonian Fishes of Gemünden in Western Germany." *Trans. Roy. Soc., Edin.*, with Supp., 1905.

His monograph on the British Asterolepidæ (*Palæontographical Society*) is now nearly completed.

The great advance in Scottish fossil ichthyology during the last twenty years has been chiefly due to the researches of Dr. Traquair. In his presidential address to the Royal Physical Society, in 1900, Dr. Peach stated that up till that time Dr. Traquair had described no fewer than eighty new species of fishes from the palæozoic rocks of Scotland; fifty-four from the Carboniferous, eighteen from the Old Red Sandstone, and eight from the Silurian rocks.

These investigations have had an important bearing on stratigraphy. They have confirmed the close relationship of the fish fauna of the Old Red Sandstone of Scotland south of the Grampians with that of the West of England and the Welsh border. Dr. Traquair has also

emphasised the great difference in the fish fauna of the rocks of the "Orcadian" series and that of the Lower Old Red Sandstone or "Caledonian" series of Forfarshire. Only two genera, and not a single species, are common to the two sets of rocks. He has also shown that not only the rocks of the "Orcadian" series, but also those of the Upper Old Red Sandstone of the North of Scotland, may be "zoned" by means of their fish remains. As regards the Carboniferous system, Dr. Traquair's researches have shown that a pretty sudden change in the estuarine fish remains takes place in the Millstone Grit, whereby two great zones in the fish life of the period are marked out.

In addition to the honours already mentioned, Dr. Traquair has received medals from the Royal Society of Edinburgh, the Lyell medal from the Geological Society of London, and, in 1907, a Royal medal from the Royal Society of London for "discoveries relative to fossil fishes." He was elected a Fellow of the Royal Society of London in 1881, received the honorary degree of LL.D. from Edinburgh University in 1893, and was President of the zoological section of the British Association in 1900. He is at present one of the Vice-Presidents of the Royal Society of Edinburgh.

His contributions to our *Transactions* are as follows:—

"On a Specimen of *Psephodus magnus*, Agassiz, from the Carboniferous Limestone of East Kilbride." Vol. vii., pp. 392-402.

"On *Cladodus Neilsoni*, Traquair, from the Carboniferous Limestone of East Kilbride." Vol. xi., pp. 41-50.

"The Bearing of Fossil Ichthyology on the Doctrine of Evolution." (Abstract.) Vol. xi., pp. 269-270.

"Extinct Birds." (Abstract.) Vol. xi., pp. 287-288.

"The Vertebrate Animals of the Coal Period." (Summary.) Vol. xii., pp. 224-225.

"Hugh Miller and his Palæichthyological Work." (Summary.) Vol. xii., pp. 257-258.

The Present Position of the Society.

Professor Edward Hull, LL.D., F.R.S., F.G.S.

Professor Hull was born in Antrim on 21st May, 1829, and was a son of the late Rev. John D. Hull, Vicar of Wickhambrook. He graduated in Trinity College, Dublin, in 1850, and received a diploma for engineering the same year. In that year also, on the recommendation of the late Professor Oldham, he was appointed on the staff of the Geological Survey, under Sir H. T. De la Beche and Professor (afterwards Sir Andrew C.) Ramsay.

After carrying out the Geological Survey of a large part of England in the Western and Midland counties, including that of the Lancashire and Cheshire coalfields, Professor Hull was promoted to the position of District Surveyor to the Survey of Scotland in 1867, under Sir Archibald Geikie, and during the two years in which he retained this position he surveyed the Lanarkshire coalfield and adjoining districts. While in Glasgow he made the acquaintance of many scientific friends, and on joining the Geological Society of Glasgow he accompanied the members in excursions to places of geological interest around the neighbourhood. Amongst the chief of his friends were the late Mr. Alexander Drew, of Blairmore, and Dr. James Bryce, of the Glasgow Academy. In 1869 Professor Hull was appointed Director of the Geological Survey of Ireland, under Sir Roderick I. Murchison, and also Professor of Geology in the Royal College of Science, Dublin. In 1873 he was elected President of the Royal Geological Society of Ireland, and at the Belfast meeting of the British Association in 1874 he presided over the Geological Section. In 1879 he received the honorary degree of LL.D. from the University of Glasgow, on the occasion of the installation of the late Duke of Buccleuch as Chancellor, an honour chiefly due to the publication of his work on "The Coalfields of Great Britain," now in its fifth edition.

It was during this part of his life that he was nominated by the committee of the Palestine Exploration Fund,

on the recommendation of the late Major-General Sir Charles W. Wilson, to take the command of an expedition organised for making a Geological and Topographical Survey of the Arabah Valley and the tract lying between the Sinaitic Peninsula and Southern Palestine. In this expedition he was accompanied by Captain (now General Lord) Kitchener of Khartoum, who had charge of the Topographical Survey. The expedition was completed in about four months, and the results are recorded in a "Memoir on the Geology of Arabia Petræa and Palestine," and a narrative of the journey in "Mount Seir" is given, both published by the Palestine Exploration Society, and written by him.

In 1890 Professor Hull received the Murchison medal from the Geological Society of London in consideration of his contributions to geological literature, and his investigations regarding the physical structure of the British Islands and other countries, including that of the Holy Land. It was in the same year that, having served for forty years, he retired from the public service on his pension, and removed his residence to London, where he has since carried on professional business as consulting geologist, and has assisted by his advice in carrying out public works connected with the water supply of large towns, such as Nottingham, Lincoln, St. Helens; and, on the formation of the London Water Board, he was called in to advise regarding the supply of underground water from the Chalk. Professor Hull was appointed a member of the Royal Commission on Coal Reserves, under the presidency of the Right Hon. Lord Allerton, in 1901, which sat for three years, and in 1905 issued an elaborate report in three large volumes dealing with the subject of our coal resources. In 1900 he was elected secretary to the Victoria Institute of London, a position which he held down to the present year, and during this period he carried on investigations regarding the extension of the river valleys of the British Isles and

Western Europe under the waters of the ocean down to depths of 6000 to 7000 feet, where they open out on the abysmal floor. Professor Hull considers this his most important work, as it opens up a wide view of great changes of level in late Tertiary times and affords an intelligible cause of the Glacial epoch. The submerged river valleys can be determined by tracing iso-bathic lines on the Admiralty charts by aid of the soundings, by means of which these grand cañons can be accurately defined as traversing "the Continental platform" from their upper origin down to the base of the platform, at a depth of 6000 to 7000 fathoms. These researches were commenced in 1898, on the publication of similar ones carried out by Professor J. W. Spencer along the eastern seaboard of America, and are published in the *Transactions of the Victoria Institute*, of which a list is appended, as well as in other publications.

The following is a list of some of Professor Hull's more recent papers:—

1. "Holy Scripture Illustrated and Confirmed by Recent Discoveries in Palestine and the East." *Transactions of the Victoria Institute*, vol. xxviii.
2. "On the Age of the Last Uprise of the British Isles." *Ibid.*, vol. xxxvi.
3. "Where is Mount Sinai?" *Ibid.*, vol. xxxi.
4. "Investigations regarding the Submerged Terraces and River Valleys bordering the British Isles." *Ibid.*, vol. xxx.
5. "Sub-oceanic Terraces and River Valleys off the Coast of Western Europe." *Ibid.*, vol. xxxi.
6. "Sub-oceanic River Valleys of West African Continent and of the Mediterranean Basin." *Ibid.*, vol. xxxii.
7. "Another Possible Cause of the Glacial Epoch." *Ibid.*, vol. xxxi.
8. "The Physical History of the Norwegian Fjords." *Ibid.*, vol. xxxiv.

9. "The Spread of Existing Animals through Europe and to the Isles of the Atlantic." *Ibid.*, vol. xl.

It need only be added that Professor Hull is the author of numerous works, of which, perhaps, the most important is "The Coalfields of Great Britain," referred to above, in addition to several memoirs drawn up for the Geological Survey of Great Britain and Ireland.

Professor Hull's contributions to the *Transactions* of our Society are as follows:—

"On the Causes which seem to have regulated the Relative Distribution of the Calcareous and Sedimentary Strata of Great Britain, with Special Reference to the Carboniferous Formation." Vol. iii., pp. 33-44.

"On the Microscopical Structure of Red Quartz Porphyry from the Old Red Sandstone of Logan Water above Lesmahagow." Vol. v., pp. 25-28.

"Classification of the Carboniferous Rocks of Scotland." Vol. vi., pp. 250-254.

PROFESSOR JAMES GEIKIE, LL.D., D.C.L., F.R.S.

James Geikie, a younger brother of Sir Archibald, was born in Edinburgh in 1839, and educated at the High School and at Edinburgh University. In 1861 he entered the Geological Survey of Scotland, and served in it for twenty years. In 1882, when Sir Archibald Geikie resigned the post of Murchison Professor of Geology in Edinburgh University, his brother was appointed to the position, which he still holds.

Professor Geikie's name will always be identified with the glacial geology of Scotland. His splendid work, "The Great Ice Age," was published in 1874, and remains one of the most important works ever published on glaciology. He was the first to point out that the

Scottish peat mosses furnished evidence of cold and wet conditions of climate having alternated with more genial periods (*Trans. Roy. Soc. Edin.*, 1866). In the past few years these results have been confirmed by botanical evidence obtained by Mr. Lewis and embodied in a series of papers in the *Transactions of the Royal Society of Edinburgh*. Professor Geikie has therefore consistently maintained the view that the Glacial period, commencing in late Pliocene times, was marked by an alternation of cold and genial climatic conditions.

Much of Professor Geikie's most important work has dealt with the origin of the surface features of the land. Several of the essays in "Fragments of Earth Lore" (1892) deal with this subject, and he has treated it in detail in "Earth Sculpture," published in 1898. In 1905 "Structural and Field Geology" was published, a special feature of which is the admirable way in which all important points in the text are illustrated by beautiful photographic plates.

For many years Professor Geikie has been a strong advocate of the importance of geography as a subject for instruction not only in schools, but in universities. He was one of the founders of the Royal Scottish Geographical Society, and is still its president and honorary editor. Many of his most illuminating essays have dealt with geographical problems. His studies have ranged over a wide field, and have not been confined solely to scientific investigations. Like his brother he has always been a keen student of foreign literature, and in 1887 he published "Songs and Lyrics by Heinrich Heine."

Professor Geikie's contributions to our *Transactions* are as follows:—

"On Denudation in Scotland since Glacial Times." Vol. iii., pp. 54-74.

"Note on the Occurrence of Erratics at Higher Levels than the Rock Masses from which they have been derived." Vol. iv., pp. 235-241.

The Present Position of the Society.

"Notes on the Geology of Colonsay and Oronsay." Vol. vi., pp. 157-164.

The reputation of the Glasgow Society has always been considerable, particularly in the branches of palæontology, stratigraphy, and glacial geology. We can fairly claim that we possess at the present time a band of contributing members who have worthily carried on the traditions of those who erected the Society on the firm basis of valuable work done and recognised. John Smith, of Ayrshire, in glacial geology; James Neilson and Robert Dunlop, in palæontology; Peter Macnair, in the geology of the Highland boundary (to give but a few names), have more than a local reputation. Finally, in our recently elected president we have been fortunate in obtaining a geologist and geographer of international reputation, worthy to continue the high traditions of an office held by a succession of the most eminent geologists in Britain. With the help of these, and promising younger workers eager to make their reputations, we may look forward with confidence to the continued and increasing usefulness of the Society. By one thing we must stand or fall, namely, the value of our contributions to our chosen science, and with the work described in the earlier chapters as our inspiration, we may fairly predict that at the end of other fifty years the Glasgow Society will be found a living force in geology.

APPENDIX.

Presidents of the Society and Date of Election.

James P. Fraser, F.R.S.E.,	elected	7th	October,	1858
John Scouler, M.D. LL.D.,	„	6th	„	1860
James Smith, F.R.S., F.G.S.,	„	6th	„	1864
Professor John Young	„	7th	March,	1867
Sir William Thomson,	„	8th	February,	1872
Sir Archibald Geikie,	„	9th	November,	1893
Professor Charles Lapworth,	„	9th	„	1899
R. H. Traquair, LL.D., F.R.S.,	„	14th	„	1902
B. N. Peach, LL.D., F.R.S.,	„	9th	„	1905
Professor J. W. Gregory, D.Sc., F.R.S.,	„	12th	„	1908

Vice-Presidents of the Society and Date of Their First Election.

E. A. Wünsch, - -	elected	17th	May,	1858
Thomas Struthers, - -	„	6th	October,	1859
John Young, - - -	„	6th	„	1859
Rev. Henry W. Crosskey,	„	6th	„	1864
James Thomson, F.G.S.,	„	6th	„	1864
John Scouler, M.D., F.L.S.,	„	5th	„	1865
Edward Hull, M.A., F.R.S.,	„	1st	„	1868
James Geikie, - -	„	7th	„	1869
D. C. Glen, C.E., F.G.S.,	„	18th	November,	1875
James Dairon, - -	„	2nd	„	1876
David Sandeman, - -	„	1st	„	1877
Archibald Robertson, -	„	4th	„	1880
Dugald Bell, - - -	„	10th	„	1881
David Forsyth, M.A., -	„	9th	„	1882
William Jolly, F.G.S., -	„	12th	„	1885
Daniel M'Millan, - -	„	11th	„	1886
Joseph Sommerville, -	„	8th	„	1888
John Smith, - - -	„	12th	„	1891

William Armour, C.E., -	elected	10th	November,	1892
John Dansken, F.S.I., -	„	9th	„	1893
James Neilson, - -	„	8th	„	1894
James Anderson, - -	„	14th	„	1895
Robert Dunlop, - -	„	12th	„	1896
John Renwick, - -	„	11th	„	1897
Bailie William Maclay, -	„	10th	„	1898
Matthew Blair, - -	„	9th	„	1899
Robert Kidston, LL.D., F.R.S.,	„	8th	„	1900
James Stark, - -	„	14th	„	1901
James Steel, - -	„	14th	„	1902
Charles R. Cowie, - -	„	12th	„	1903
David Chalmers, - -	„	10th	„	1904
R. W. Dron, - -	„	9th	„	1905
Professor Gregory, F.R.S.,	„	8th	„	1906

Secretaries of the Society.

Mr. William Kirkland was one of the founders of the Society, and was elected the first Secretary on 17th May, 1858, and held office until 6th October, 1859. Although he did not hold office very long, he did good work in getting the Society into working order. He died in 1897, from the result of an accident which he met with in Argyle Street.

He was succeeded in the secretaryship by Mr. James Horne, who held the office until October, 1864; up to this time the Secretaries also acted as Treasurers, when the offices were separated. On Mr. Horne resigning the secretaryship, he was elected Treasurer. The third Secretary was Mr. James Farie, who held the office for two years. He resigned owing to his business taking him out of Glasgow. Messrs. Horne and Farie were elected Honorary Associates in 1871. Mr. Farie was succeeded by Mr. James Macalister, who held office until his death, which took place between the meeting of the Society on 7th January and that of 4th February, 1869, on which latter date Mr. James Armstrong was elected Secretary, and held office until October, 1870. At the meeting of the 6th October, 1870, Mr. Dugald Bell and Mr. John

Burns were elected Joint Secretaries. Mr. Bell also edited the *Transactions*. They had been edited from 1864 by Mr. James Armstrong. Mr. Bell, owing to his business taking him to India, resigned in 1875, when Mr. James Barclay Murdoch was elected, and, as is well known to most of the members, he was Secretary for thirty years. Mr. John Burns continued to act as Joint Secretary until 1877. He was succeeded by Mr. Gavin M. Pratt, who held office for twenty-two years, that is, until 1900. Mr. Pratt did a large amount of useful work, and deserves the best thanks of the Society. Mr. Peter Macnair in 1900 took up the work which Mr. Pratt had performed, until 1905, when Mr. Murdoch resigned owing to failing health. Mr. Frederick Mort was then associated with Mr. Macnair in the secretarial work and editing of the *Transactions*.

Treasurers of the Society.

As has already been mentioned, up to 1864 the offices of Secretary and Treasurer were combined. In that year Mr. James Horne was elected Treasurer, and continued to act until 1868, when he left Glasgow. Mr. John Wight, C.A., was then elected Treasurer, and held the office for thirty-three years. The Society lately presented him with a small token in remembrance of his long term of office. In 1901 Mr. Wright's son, Mr. E. Hall Wight, the present Treasurer, was elected.

Librarian and Curator of the Museum.

In the first printed constitution of the Society rule 6 reads—" A Geological Museum and Library to be formed as soon as found expedient," and in the list of members published for 1863-64 there is a list of books and specimens presented to the Society. Mr. James Armstrong no doubt took charge of these. He was

appointed Librarian and Curator on the 6th October, 1864, and held these offices until he accepted the secretaryship in 1869. The following have held the office since:—

Mr. Thomas Naismith,	- - from	1869 to 1872
„ Richard Neilson,	- - - „	1872 to 1880
„ Joseph Sommerville,	- - „	1880 to 1884
„ James White,	- - - „	1884 to 1894
„ James S. M'Lennan,	- - „	1894 to 1905
„ William Sinclair,	- - „	1905 to the present time.

The specimens for the Museum were added to by gift and purchase, until it assumed proportions for which accommodation could not be found to make it useful. When the Society removed in 1880 to the present rooms it could not be made use of at all, and it was disposed of to the Corporation of Glasgow in 1899, and is now in the Museum of Science and Art at Kelvingrove.

The Library has grown along with the Society, and is a very valuable one. New books on geological and kindred subjects are being added to it from year to year. It may be mentioned that the want of accommodation prevents it being as useful as it ought to be.

Meeting Places of the Geological Society of Glasgow.

The Society having started with the laudable ambition of forming a Library and Museum, it was with considerable difficulty rooms could be obtained at that time to suit them. Mr. Barr, in his paper " The Origin and Early History of the Society," has given in detail the meeting places of the first session, and states that they had made arrangements with the managers of the Athenæum, then in Ingram Street, to hold their ordinary meetings there during the second session. There were ten meetings held there from November, 1858, until 7th July, 1859.

Appendix.

From the beginning of the third session, which commenced on the 6th October, 1859, until May, 1863, they had no fixed place of abode. We find them meeting in the Religious Institution Rooms, the Athenæum, the Merchants' Hall, Hutcheson Street; and the Mechanics' Institution, 38 Bath Street. In May, 1863, they removed to the Andersonian University, George Street, that splendid nursery for young scientific societies. Here the Society had its rooms until October, 1880. Although it is twenty-eight years since they removed from there, many members will have recollections of the rooms there, with the library and cases of specimens displayed round the walls. The Andersonian University, by an Act passed in 1877, changed its name to Anderson's College, and was making rapid strides in technical education, and required all the accommodation for their classes.

The Society removed to its present rooms, 207 Bath Street, the property of the Royal Philosophical Society, in November, 1880.

THE GEOLOGICAL SOCIETY OF GLASGOW.

INSTITUTED 1858.

CONSTITUTION as Amended,

SESSION 1905-06.

I.—NAME.

The Society shall be called "The Geological Society of Glasgow."

II.—OBJECTS.

The objects of the Society shall be—

I. To unite, in permanent working association, the students and friends of Geological Science in Glasgow and surrounding districts.

II. The advancement of that science, by means of periodical Meetings for its study; the reading and discussion of Papers on subjects illustrative of Geology or its allied Sciences; the exhibition and description of specimens; the delivery of Lectures; and by Excursions.

III. The formation of a Library chiefly relating to Geology, Palæontology, Petrography, and Mineralogy.

IV. The publication of the Society's *Transactions* and *Proceedings*.

III.—MEMBERS.

The Society shall consist of Ordinary, Associate, Honorary, Honorary Associate, and Corresponding Members.

IV.—ORDINARY AND ASSOCIATE MEMBERS.

All candidates for Membership shall be proposed on the recommendation of two Members, and their names announced

in the circular calling an Ordinary or Special Meeting, at which Meeting their election shall be put to the vote from the chair. If not unanimous, the vote shall be taken by ballot.

The Annual Subscription shall be—for Ordinary Members—Gentlemen, 10s., and Ladies, 7s. 6d., payable upon election, and thereafter at the first Ordinary Meeting of each Session in October.

A single payment of Five Guineas shall entitle any Member elected as aforesaid to be entered as a Life Member.

Students attending Geological Classes shall be eligible for admission as Associate Members for the current Session at a Subscription of 2s. 6d., with the right of attending all Meetings and Excursions, and of using the Library, but not of voting, nor of receiving the *Transactions*.

Members whose Subscriptions are in arrears shall not be entitled to vote, nor to use the Library, nor to receive the *Transactions*.

Members shall be held liable for their Annual Subscriptions until they have given written notice of their resignation.

V.—HONORARY MEMBERS, HONORARY ASSOCIATES, AND CORRESPONDING MEMBERS.

The Ordinary Members shall have power to elect—on the motion of two of their number—Honorary Members, Honorary Associates, and Corresponding Members, at any Meeting, provided that notice of the said motion has been given at a previous Meeting and received the sanction of a majority of the whole Council. The votes of two-thirds of the Members present and voting shall be requisite for the election of all such Members.

(1.) Persons distinguished for their attainments in Geology or the allied Sciences shall be eligible as Honorary Members. These shall be entitled to the same privileges as Ordinary Members.

(2.) Persons resident in Glasgow or neighbourhood, who may have benefited the Society by services rendered, by donations of books, or by the contribution of original communications, shall be eligible as Honorary Associates.

(3.) Friends and Students of Geological Science resident at a distance from Glasgow, who may be willing to forward information

or communications to the Society, shall be eligible as Corresponding Members.

Honorary Associates and Corresponding Members shall be entitled to attend the Meetings, Lectures, and Excursions, but shall have no vote in the management of its affairs, nor be entitled to receive copies of the *Transactions*, except at the discretion of the Council.

VI.—OFFICE-BEARERS.

The business of the Society shall be conducted by a Council of twenty-one, consisting of a President, three Vice-Presidents, two Secretaries, a Treasurer, a Librarian, an Editor of *Transactions*, and twelve Councillors.

The election of Office-Bearers shall take place by ballot, at the Annual General Meeting. The names of those proposed to fill the various offices, together with their proposers and seconders, shall be sent in to the Secretaries at least eight days before the Annual General Meeting, and submitted to a meeting of Council, and printed in the Circular calling that Meeting.

They shall take office for three years. The President, Secretaries, Treasurer, Librarian, and the Editor of *Transactions* shall be eligible for re-election. The senior Vice-President and the four senior Councillors shall not be eligible for re-election to such offices as those they retire from in rotation until they have remained one year out of office.

VII.—CHAIRMAN.

In the absence of the President, or by arrangement with him, one of the Vice-Presidents, or, failing them, a Member of Council, shall preside. The Chairman shall have a deliberative and a casting vote.

VIII.—SECRETARIES.

The Secretaries shall act both for the Society and the Council, and shall give due intimation of all Meetings of the Society and the Council, record the proceedings of the Meetings in the Minute-Books, prepare abstracts thereof for publication in the newspapers, keep a register of the names and addresses of

Members and Associates, and conduct the general correspondence of the Society. They shall be *ex officio* members of all Sub-Committees.

IX.—TREASURER.

The Treasurer shall receive and pay (as authorised by the Council, or by any General or Special Meeting of the Society) all moneys connected with the Society, and shall keep a regular account of the same, which account shall be balanced as on the 30th September of each year, audited by two Members, who shall not be Members of Council at the time, and submitted to the Annual Business Meeting in November.

X.—LIBRARIAN.

The Librarian shall have charge of the Library and all other property belonging to the Society, and shall arrange and keep a Catalogue thereof.

The *Transactions* shall be exchanged with such Societies and Geological Authors at home and abroad as may be approved of by the Council. The Librarian shall have charge of such exchanges, and shall keep a correct list of the same. Members shall have access to the Library on the nights of Meeting, and at such other times as the Council shall arrange.

XI.—EDITOR OF TRANSACTIONS.

The Editor shall attend to the preparation of the material for the Society's *Transactions* and *Proceedings*. A Publishing Committee, of which the Editor shall be Convener, shall be appointed annually by the Council, and shall decide as to all papers or abstracts of papers to be printed, and the illustrations to accompany them.

XII.—COUNCIL.

The Council shall meet as often as may be requisite for the transaction of the Society's business, and five shall form a quorum. They may appoint Sub-Committees for the management of special business. They shall make arrangements for the Winter Session, and also for the Excursions. They shall prepare a report of the

affairs of the Society for the past year to be submitted to the Annual General Meeting.

Any vacancy occurring during the year may be filled up by the Council; but such appointments shall only be for the unexpired portion of the previous occupant's term of office. Members so elected shall, however, be eligible for re-election if their period of such office has not extended beyond two years.

XIII.—MEETINGS.

Ordinary Meetings of the Society shall be held once a month during the Session, commencing on the second Thursday evening in October, at eight o'clock, but more frequently if the Council should deem it advisable. At these Meetings the order of business shall be as follows:—The Minutes of the previous Meeting shall be read and confirmed; the vote taken on any candidates whose names have been duly proposed for Membership; the names of those applying for Membership submitted; specimens of geological interest exhibited and remarked upon; papers read and discussed, and any other competent business disposed of. The second Meeting of each Session shall be the Annual General Business Meeting, at which one of the Secretaries shall read the report of the Council for the past year; the Treasurer shall submit the Financial Statement; the Librarian shall report on the state of the Library, and the Editor of *Transactions* report on the progress of the Publications of the Society. The election of Office-Bearers shall then be proceeded with, and the ordinary business follow.

Special Meetings.

The Council shall be empowered to call, at any time when necessary, a Special Meeting of the Society, and shall be bound to do so on the written requisition of ten Members, specifying the business to be submitted thereto.

At all Meetings the resolutions of a majority of those present and voting—with the exceptions stated in Laws V. and XVI.—shall be binding.

XIV.—VESTING OF PROPERTY.

The property of the Society shall belong solely to the Ordinary Members, and shall be vested for their behoof in the Council for

the time being. The Council shall have the management of the property, and power to sell or otherwise dispose of any duplicate Books or copies of the *Transactions* at prices they may arrange. Any other property which they may consider unnecessary to retain shall only be disposed of with the consent of a majority of the Ordinary Members present at a Meeting of the Society, and notice shall be given in the Circular calling the Meeting of the intention to ask such consent.

XV.—APPLICATION OF FUNDS.

The Annual Subscriptions, and the annual revenue from Life-Membership Subscriptions, shall be devoted to the general work of the Society, special attention being given to the printing and illustrating of the Society's *Transactions*, of which all Ordinary Members shall be entitled to receive a copy of each Part published during their term of membership.

Should the Subscriptions at any time be insufficient for this purpose, the Council shall have power to fix such a charge for each Part of the *Transactions* as may be required to make up the deficiency.

Papers printed in the *Transactions* shall entitle the Authors to receive thirty copies of their papers free.

Sums may be voted from time to time by the Council for the Library and for other purposes out of any funds there may be on hand, but not exceeding Two Pounds in value without the sanction of a General Meeting.

The capital from the Life-Membership Subscriptions shall be retained as a separate Fund for the re-publication of such Memoirs or Parts of the *Transactions* as may become out of print, and be still in demand; for special Publications or of Exhibitions in connection with the visits of other learned Societies; and generally for such exceptional purposes as are not provided for by the Annual Subscriptions.

The Council shall obtain the sanction of a Meeting of the Society before applying any portion of this Fund in such way.

XVI.—ALTERATION OF THE CONSTITUTION.

No alteration shall be made in the Constitution of the Society except at a Meeting of which special intimation has been given

by Circular issued for that purpose. Notice of any proposed alteration shall be made at the Meeting preceding, and shall not be adopted unless agreed to by two-thirds of the Members present and voting.

XVII.

Any contingency not provided for in the foregoing Rules shall be submitted to the Council, and their decision shall be final and binding on all concerned.

THE

GEOLOGICAL SOCIETY OF GLASGOW.

INSTITUTED 1858.

OFFICE-BEARERS FOR SESSION 1908-1909.

President—

Prof. J. W. GREGORY, D.Sc., F.R.S.

Vice-Presidents—

For Three Years.

Mr. JAMES NEILSON (Milnbank).

For Two Years.	*For One Year.*
Mr. JOSEPH SOMMERVILLE.	Mr. JOHN RENWICK.

Members of Council—

Mr. R. W. DRON.	Mr. DAVID CHALMERS.	Mr. C. R. COWIE.
Mr. JOHN M'KELLAR.	Mr. ROBERT DUNLOP.	Mr. E. W. GEMMELL.
Mr. JAMES STARK.	Mr. A. MACINTYRE.	Mr. J. W. REOCH.
Mr. ROBERT BOYLE.	Mr. G. W. TYRRELL.	Mr. M. MONIE.

Honorary Secretaries—

Mr. PETER MACNAIR, F.R.S.E., F.G.S., Kelvingrove Museum.

Mr. FREDERICK MORT, M.A., B.Sc., F.G.S., F.R.S.G.S., 116 York Drive, Hyndland.

Honorary Treasurer—

Mr. E. HALL WIGHT, 150 Hope Street.

Honorary Librarian—

Mr. WILLIAM SINCLAIR, 45 Oswald Street.

Honorary Editors of "Transactions"—

Mr. PETER MACNAIR. | Mr. FREDERICK MORT.

Auditors—

Mr. DAVID PEARSON. | Mr. ARCH. A. YOUNG.

LIST OF MEMBERS.

Honorary Members.

Year of Election.

1863. Geikie, Sir Archibald, D.C.L., LL.D., F.R.S., &c., Shepherd's Down, Haslemere, Surrey.

1867. Jones, T. Rupert, F.R.S., F.G.S., 17 Parson's Green, Fulham, London, S.W.

1871. Hull, Edward, M.A., LL.D., F.R.S., F.G.S., 20 Arundel Gardens, Notting Hill, London, W.

1883. Judd, J. W., C.B., LL.D., F.R.S., F.G.S., 22 Cumberland Road, Kew, London.

1888. Murray, Sir John, K.C.B., LL.D., F.R.S., F.R.G.S., Challenger Lodge, Wardie, Edinburgh.

1900. Gray, Mrs. Robert, 59 George Street, Edinburgh.

1902. Geikie, James, LL.D., D.C.L., F.R.S., F.G.S., F.R.G.S., Kilmorie, Colinton Road, Edinburgh.

1902. Horne, John, LL.D., F.R.S., F.G.S., Geological Survey Office, Edinburgh.

1902. Lapworth, Charles, LL.D., F.R.S., F.G.S., University of Birmingham.

1902. Peach, B. N., LL.D., F.R.S., F.G.S., Geological Survey Office, Edinburgh.

1902. Traquair, R. H., M.D., LL.D., F.R.S., F.G.S., Museum of Science and Art, Edinburgh.

1904. Jolly, Wm., F.R.S.E., Blantyre Lodge, Blantyre.

1907. Murdoch, Mrs. J. B., Capelrig, Newton Mearns.

1909. Smith, John, Dykes, Dalry, Ayrshire.

1909. Suess, Eduard, Vienna.

1909. Hind, Wheelton, M.D., B.S., F.R.C.S., Roxeth House, Stoke-on-Trent.

List of Members.

Corresponding Members.

Year of Election.

1864. Mitchell, Rev. Hugh, LL.D., Craig, Montrose.
1867. Kerr, David, Wemyss Colliery, Fifeshire.
1871. Jack, R. L., LL.D., F.G.S., 36 Overstrand Mansions, Battersea Park, London.
1871. Jamieson, T. F., F.G.S., Ellon, Aberdeenshire.
1883. Scott, Thomas, F.L.S., Menzies Road, Torry, Aberdeenshire.
1884. Dobbie, J. J., M.A., D.Sc., Museum of Science and Art, Edinburgh.
1884. Nathorst, Professor Alfred Gabriel, Stockholm, Sweden.
1898. Livingston, Colin, Ardtraigh, Fort-William.
1909. Young, James, Lesmahagow.

Ordinary Members.

[An asterisk (*) indicates a Life Member.]

1905. Anderson, E. M., H.M. Geological Survey Office, 33 George Square, Edinburgh.
1882. Anderson, James, 27 St. Vincent Crescent, Glasgow.
1908. Anderson, P. J., M.A., LL.B., University Library, Aberdeen.
1898. Bain, James, Whins House, Alloa.
1894.*Barlas, George, 15 Ruthven Street, Glasgow.
1894.*Barr, Professor Archibald, Royston, Dowanhill, Glasgow.
1894.*Barr, James, M.I.C.E., F.S.I., 221 West George Street, Glasgow.
1893. Barr, Patrick, 51 Bath Street, Glasgow.
1907. Bayne, G. A. C., Jamadoba Colliery, P.O. Jharia, E.I. Railway, India.
1903. Beattie, William, Dineiddgg, Milngavie.
1908. Beckett, Samuel, Lethenvale, Hamilton.
1905. Begg, James L., Artist, Elms, Mount Vernon.
1900. Begg, Thomas, Elms, Mount Vernon.
1906. Bennett, Professor Peter, Technical College, George Street, Glasgow.
1902. Blackwood, Matthew, Ardmore, Port-Glasgow.
1908. Boyle, Robt., B.Sc., c/o Mrs. Finnie, 95 Hill Street, Garnethill.
1895. Brown, Rev. Alex., 4 Leslie Road, Pollokshields.

List of Members.

Year of Election.

1892. Brown, John A., 4 Prince Albert Road, Dowanhill, Glasgow.
1904. Buchanan, R. MacNeil, M.B., C.M., F.F.P.S.G., 2 Northbank Terrace, Kelvinside.
1904. Buchanan, W. Arthur, 18 Bute Gardens, Hillhead.
1894. Burnett, John James, A.R.S.A., 70 University Avenue, Hillhead.
1902. Burns, Daniel, M.I.M.E., Technical College, George Street, Glasgow.
1907. Campbell A. G., 8 Walmer Terrace, Ibrox.
1903. Campbell, Bailie Archd., Springfield Quay, Glasgow.
1877. Campbell, John MacNaught, 6 Franklin Terrace, Glasgow.
1905. Carmichael, John, 1399 Argyle Street, Glasgow.
1880. Carmichael, Robert S., Audit Office, St. Enoch Station, Glasgow.
1906. Carruthers, R. G., H.M. Geological Survey Office, Edinburgh.
1895.*Cassells, John, 154 Queen's Drive, Crosshill.
1895. Chalmers, David, 16 Berkeley Terrace, Glasgow.
1906. Chapman, Joseph, Kuardi Colliery, Kuardi Coal Co., Ltd., Kaliphari P.O., E.I.R., Bengal, India.
1903. Clarkson, William, Quarrymaster, Friar's Park, Lesmahagow.
1905.*Clough, C. T., M.A., H.M. Geological Survey Office, 33 George Square, Edinburgh.
1891. Cowie, Charles, R., Woodend, Partick.
1900.*Cozens, Samuel F., Salem, Skelmorlie.
1907. Currie, Robert, A.G.T.C., M.I.M.E., Sorn Rd., Auchenleck, Ayrshire.
1894. Dixon, Walter, Derwent, 30 Kelvinside Gardens, Kelvinside.
1883.*Dobbie, C. Lizars, 21 St. James Street, Hillhead.
1905. Dobson, D. Bennett, 108 Douglas Street, Glasgow.
1907. Donald, W., Manufacturer, 60 Firhill Road, Glasgow.
1897. Donaldson, Archibald, 10 Abercromby Street, Glasgow.
1881.*Dougan, John, 69 Cadder Street, Pollokshields.
1908. Dougan, John, 23 Smith Street, Hillhead.
1887. Dow, William, 141 Stanmore Road, Mount Florida.
1895. Dron, R. W., A.M.I.C.E., 55 West Regent Street, Glasgow.
1906. Drummond, John, 35 High Street, Airdrie.
1906. Drylie, James, 45 Minard Road, Crossmyloof.
1883. Dunlop, Robert, Rosemount, Weirwood Park, Shettleston.

List of Members.

Year of Election

1901. Du Toit, Alex. L., B.A., Geological Commission, South African Museum, Cape Town, S.A.
1906. Elliot, George B., 33 Millbrae Road, Langside.
1901. Faill, John, 7 Winton Drive, Kelvinside.
1898. Fergus, A. Freeland, M.D., 22 Blythswood Square, Glasgow.
1906.*Ferguson, Professor, M.A., LL.D., 13 Newton Place, Glasgow.
1895. Fingland, Mrs., Braehead Villa, Cathcart.
1897. Fingland, Samuel, Braehead Villa, Cathcart.
1895. Forbes, Alexander, Lecturer on Mining, 9 Midton Road, Ayr.
1898.*French, Thomas, 1 Kelvinside Terrace, Kelvinside.
1905. Fyfe, John William, 221 West George Street, Glasgow.
1901. Gale, William M., C.E., 18 Huntly Gardens, Kelvinside.
1892. Galloway, T. Lindsay, C.E., 175 West George Street, Glasgow.
1887. Gardner, John, 65 Great Clyde Street, Glasgow.
1901. Gemmell, E. W., 34 Carmichael Place, Langside.
1893. Gemmell, Matthew, 160 Bath Street, Glasgow.
1894.*Gilfillan, William, 185 St. Vincent Street, Glasgow.
1873.*Gilmour, Thomas, M.D., Port Ellen, Islay.
1895. Glen, Alexander, 25 Dumbreck Road; Glasgow.
1894. Goldie, James, J.P., 52 St. Enoch Square, Glasgow.
1877.*Graham, M. M., 21 Bath Street, Glasgow.
1904. Gray, John, 86 Minard Road, Crossmyloof.
1904. Gregory, John Walter, D.Sc. F.R.S., Professor of Geology, Glasgow University.
1907. Hall, Rev. C. A., Meeresbrook, Meikleriggs, Paisley.
1872. Hamilton, Archd., C.E., Clyde Navigation Office, 16 Robertson Street, Glasgow.
1907. Harper, Robert, Myrtle Cottage, Early Braes, Duntocher Road, Shettleston.
1876. Henderson, John, J.P., Ballochmorrie, Pinwherry, South Ayrshire.
1908. Hendry, David, Dunmore, Johnstone.
1903. Hill, Alexander, 11 Dolphin Road, Pollokshields.
1877. Hislop, G. R., F.C.S., F.R.S.S.E., Corporation Gas Works, Paisley.

List of Members.

Year of Election.

1891. Hodge, William, 27 Montgomerie Drive, Kelvinside.
1906. Hoggan, John, Castlecary Station, Castlecary.
1897. Houston, Robert S., 61 New Sneddon, Paisley.
1901. Howie, George, Clydeside Cottage, Uddingston.
1894. Hubbard, John James, 9 Bute Mansions, Hillhead.
1894. Hubbard, Walter Raglan, 9 Broomhill Avenue, Partick.
1908. Hunter, George, M.I.M.E., Mining Department, Technical College, Glasgow.
1901. Hunter, William, Rosemount, Ledard Road, Langside.
1903. Hurll, Mark, Redholm, Temple.
1890. Johnston, Ronald H., C.E., 190 West George Street, Glasgow.
1901. Kemp, William, c/o Mrs. Brown, 1 Doune Quadrant, Kelvinside.
1889.*Ker, William, 1 High Windsor Terrace, Glasgow.
1908. Kerr, Andrew C., 125 Buchanan Street.
1890. Kidston, Robert, LL.D., F.R.S., 12 Clarendon Place, Stirling.
1882. King, Hugh B., Kilwinning, Ayrshire.
1882. King, Robert C., C.A., Kilwinning, Ayrshire.
1892. Laird, Alexander, Caerleon, Kilmacolm.
1883. Laird, Andrew, C.E., 5 Northbank Terrace, Kelvinside.
1907. Laird, Archd. J., A.M.I.M.E., Kabulayathitti, Dharwaar District, Bombay Presidency, India.
1905. Lambie, James, M.B., L.F.P. & S., Kilwinning.
1901. Leighton, William, 36 Renfield Street, Glasgow.
1908. Leitch, P. Arthur, Saffronhall, Hamilton.
1901. Lothian, A. Veitch, M.A., B.Sc., F.R.S.E., Glendoune, Bearsden.
1899. Lyle, William, 7 Beechwood Terrace, Shettleston.
1894. M'Ara, Alexander, 19 Dundonald Road, Kelvinside.
1866. M'Clelland, Andrew S., C.A., 115 St. Vincent Street, Glasgow.
1895. M'Connell, Alexander, C.E., c/o M'Alpine & Sons, 29 St. Vincent Place, Glasgow.
1896. M'Cowan, Donald, Dundashill House, Port-Dundas, Glasgow.
1889. M'Creath, George W., M.E., 208 St. Vincent Street, Glasgow.
1904. M'Creath, William, C.E., M.I.M.E., 208 St. Vincent Street, Glasgow.

List of Members.

Year of Election.

1901. M'Culloch, Andrew, 11 West Regent Street, Glasgow.

1901. M'Culloch, Rev. J. D., Mearns Street Congregational Church, 9 Wellington Street, Greenock.

1884. M'Donald, A. B., C.E., 64 Cochrane Street, Glasgow.

1907. Macdougal, John, 37 Broomhill Drive, Partick.

1898. M'Gavin, Alexander, 23 Melrose Gardens, Kelvinside.

1894.*M'Gilvray, Robert A., 6 Newton Terrace, Charing Cross, Glasgow.

1867. M'Glashan, John, 114 Candleriggs, Glasgow.

1904. Macintyre, Archd., 60 Cadzow Street, Hamilton.

1908. Mackay, Donald, c/o Downie, Aiton & Co., 190 West George Street, Glasgow.

1898. M'Kellar, John, 25 Kelvinside Terrace South, Kelvinside.

1903. Mackenzie, W. M., M.A., 7 Dryburgh Gardens, Kelvinside.

1894. Mackie, John, M.E., Crofthead Cottage, Neilston.

1908. Moir, C. D., 150 Hope Street, Glasgow.

1907. Morrison, James, 3 Church Road, Ibrox.

1907.*Murdoch, John A. W., M.E., Morococha, Peru.

1907. Murray, Andrew G., c/o Brownlee, Watson & Beckett, Writers, 225 West George Street, Glasgow.

1908. M'Donald, David P., M.A., B.Sc., 11 Neilston Road, Paisley.

1877. Maclay, Bailie Wm., F.G.S., Thornwood Hall, Langside.

1894. Maclay, James, 3 Woodlands Terrace, Glasgow.

1903. M'Lean, Alex., 4 St. George's Road, Glasgow.

1895. Macnair, Peter, F.R.S.E., F.G.S., Art Galleries and Museum, Kelvingrove.

1897.*M'Neil, Charles, South Cliff, Wemyss Bay.

1883. M'Whirr, John, J.P., 2 St. John's Road, Cathcart.

1887. Main, John, 24 Marlborough Avenue, Partick.

1900. Mann, Andrew C., 30 Lansdowne Crescent, Glasgow.

1874. Mann, Ludovic M'Lellan, F.S.A.(Scot.), 144 St. Vincent Street, Glasgow.

1874. Marshall, Robert, Grange Hill, Beith.

1902. Menzies, James R., 72 Lauderdale Gardens, Hyndland.

1881. Mitchell, G. A., 5 West Regent Street, Glasgow.

1899. Mitchell, J. M., Banker, Auchengray, Airdrie.

1908. Monie, M. M., M.A., c/o Hannan, 8 Smith Street, Hillhead.

1904. Moore, Quintin, jun., 101 Armadale Street, Dennistoun.

List of Members.

Year of Election.

1877. Moore, Robert T., B.Sc., C.E., 142 St. Vincent Street, Glasgow.

1885 More, Robert, 505 Sauchiehall Street, Glasgow.

1907. Morrison, D. A., 97 High Street, Paisley.

1908. Morrison, James, 87 East Princes Street, Helensburgh.

1902. Mort, Frederick, M.A., B.Sc., F.G.S., F.R.S.G.S., 116 York Drive, Hyndland.

1906. Mort, Spencer, Viewfield, Partickhill.

1889. Motherwell, A. B., Rosemount, Airdrie.

1900.*Muirhead, John, 13 St. John's Drive, Pollokshields.

1898. Munro, Alexander, 63 Lauderdale Gardens, Hyndland.

1894.*Murdoch, Robert, 91 Maxwell Road, Pollokshields.

1870.*Murray, David, LL.D., 169 West George Street, Glasgow.

1891. Neilson, James, Milnbank House, Dennistoun.

1894. Neilson, James, 116 Bishop Street, Port Dundas.

1907. Neilson, Miss Agnes T., 41 West Cumberland Street, Glasgow.

1907. Nicol, J. Hall, Builder and Contractor, Hamilton.

1906. Nicolson, David G., Schoolhouse, Neilston.

1898. Nimmo, David, 17 Duke Street, Hamilton.

1894. Niven, Thomas Ogilvie, 131 West Regent Street, Glasgow.

1869.*Orr, John, 12 Newhall Terrace, Glasgow.

1905. Paisley, John, Jeweller, 25 Gordon Street, Glasgow.

1905. Paton, Robert K., c/o Evançion Gold Mining Co., Verres, Val d'Aosta, North Italy.

1875. Pearson, David, Crannich, Woodend Drive, Jordanhill.

1891. Pollok, Arthur, Kirkland, Bonhill, Dunbartonshire.

1873. Rankine, David, C.E., 238 West George Street, Glasgow.

1880. Reid, James A., LL.D., M'Grigor, Donald & Co., 172 St. Vincent Street, Glasgow.

1874. Renwick, John, 47 Oswald Street, Glasgow.

1902. Reoch, James W., 22 Montgomerie Street, Kelvinside.

1875.*Rottenburg, Paul, LL.D., Holmhurst, Dowanhill Gardens, Glasgow.

1904. Rutherford, James, M.E., 34 Granby Terrace, Glasgow.

1898. Scott, Colonel, Bellside, Cleland.

1893. Sexton, Professor A. Humboldt, Technical College, George Street, Glasgow.

1897. Shanks, Archd., Mount Pleasant, Dalry.

List of Members.

Year of Election.

1893.*Sharp, John Grant, 127 Great Hamilton Street, Glasgow.

1889. Simpson, Rev. Alex., B.A., B.Sc., F.G.S., 28 Myrtle Park, Crosshill.

1888. Sinclair, Thomas, 206 New Dalmarnock Road, Glasgow.

1887. Sinclair, William, 47 Oswald Street, Glasgow.

1889. Sloan, Samuel, M.D., 5 Somerset Place, Sauchiehall Street, Glasgow.

1908. Smith, Duncan, 3 Albion Street, Paisley.

1901. Sneddon, Richard, 66 Pitt Street, Newton, Cambuslang.

1887.*Somerville, Rev. James E., B.D., Castellar, Crieff.

1871.*Sommerville, Joseph, 40 Montgomerie Street, North Kelvinside.

1908. Sharp, R. S., 275 Nithsdale Road, Dumbreck.

1902. Spencer, James S , 14 University Gardens West, Glasgow.

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